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ABSTRACT

This document presents three main strategies that form two closely related teaching methodologies: special techniques, peer responsibility, and joint projects. The first two strategies combine together to form the first teaching methodology, Special Techniques and Peer Responsibility Teaching Method (STAPRM), and all three strategies combine together to form the second teaching methodology, Special Techniques and Peer Responsibility Teaching Method with Joint Projects (STAPRMJ). Both STAPRM and STAPRMJ reduce anxiety and improve standards in any course in which they are used. They also maximize student participation and student interaction during the course as well as student-instructor interaction. This paper discusses the 23 techniques that form the Special Techniques, some of which form a new style of teaching developed to optimize time in the classroom and the structure and organization of peer responsibility. All the examples and discussions are related to mathematics courses; however, these teaching methodologies can also be used in many other disciplines. (KHR)

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REDUCING MATH ANXIETY,
IMPROVING STANDARDS,
AND
MAXIMIZING
STUDENT PARTICIPATION AND STUDENT INTERACTION
USING
SPECIAL TECHNIQUES AND PEER RESPONSIBILITY

(*A Practical Solution for the Classroom*)

by

Mike Bankhead

The Strategies Described
in this Paper Won the
2002 Metroversity Award
for
Instructional Development

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Mike Bankhead

The Englishman's Lament

I came from afar to work over here,
Leaving all behind including good beer.
If the words that you see are not as you wish,
Please remember they're spelt in proper English!

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ABSTRACT

REDUCING MATH ANXIETY, IMPROVING STANDARDS,
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USING
SPECIAL TECHNIQUES AND PEER RESPONSIBILITY

(*A Practical Solution for the Classroom*)

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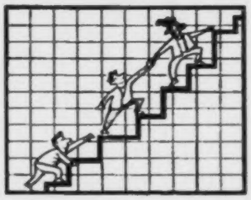
Mike Bankhead

Over the last eight years I have created, developed, and refined three main strategies that form two closely related teaching methodologies. I refer to these strategies as **Special Techniques**, **Peer Responsibility**, and **Joint Projects**. The first two strategies combine together to form the first teaching methodology, **STAPRM**, and all three strategies combine together to form the second teaching methodology, **STAPRMJ**. **STAPRM** is an acronym for Special Techniques and Peer Responsibility Teaching Method, while **STAPRMJ** is an acronym for Special Techniques and Peer Responsibility Teaching Method with Joint Projects. The only difference between them is that in **STAPRM**, each student completes a total of six assignments, two questions from each of the three example tests they receive during the semester, while in **STAPRMJ**, students complete three *Joint Projects* ***instead*** of the assignments. I use **STAPRMJ** in my Statistics courses and **STAPRM** in all my other Mathematics courses.

Both **STAPRM** and **STAPRMJ** reduce anxiety and improve standards in any course in which they are used. They also maximize student participation and student interaction during the course, as well as student-instructor interaction. There are also other advantages that were unforeseen and unexpected during the development of these teaching methodologies. For example, because there is greater student-instructor interaction, it is possible to monitor the progress of each student far better than before, and it is impossible for a student to obtain a good grade in the course because they have good partners. Each student must complete his or her own work to succeed in the course.

This paper discusses the 23 techniques that form the *Special Techniques*, some of which form the new style of teaching I developed to optimize my time in the classroom and the structure and organization of *Peer Responsibility*. The *Joint Projects* strategy, which is part of **STAPRMJ**, is not discussed in this paper. It will be discussed in a future paper. All the examples and discussions within this paper are related to Mathematics courses because this is my discipline. However, these teaching methodologies can also be used in many other disciplines.



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1. INTRODUCTION

I had been teaching for over *twenty-five years* both in **America** and **England**, when I was asked to teach a **College Algebra course** at the *100 level* during the ***spring term*** of ***1995***. Due to the differences in the educational systems between America and England, this was my first exposure to this introductory course. I was horrified at the apathy, apprehension, and lack of enthusiasm on the part of the students taking the course. Many students were attempting the course for the third or fourth time. Those repeating were quiet, almost lifeless. Some sat alone while others sat together in-groups and laughed at their own mathematical incompetence. More disturbing was their overall attitude towards the subject of Math. They had no confidence in their ability whatsoever with many of them anticipating failure before the course had even started. I was also astonished at some of the things the students did in tests and assignments. The following examples are just two of the many that I encountered while teaching this course.

EXAMPLE 1

On one of my tests, a student had ended up with the expression $\dfrac{x-y}{xy}$.

He proceeded to simplify this expression as follows :

$$\frac{x-y}{xy} = \frac{\cancel{x}-\cancel{y}}{\cancel{x}\cancel{y}} = -$$

This is literally a ***negative sign*** all by itself!

EXAMPLE 2

I was standing near a student watching her complete an exercise. She had ended up with the expression $\dfrac{\log(1+x^2)}{(1+x^2)}$. She proceeded to simplify this expression as follows :

$$\frac{\log(1+x^2)}{(1+x^2)} = \frac{\log\cancel{(1+x^2)}}{\cancel{(1+x^2)}} = \log$$

While I was surprised at what she had done, I could not help being amused at the error. So, as a joke, I said, "Surely that answer is much too big. The answer ought to be **Twig**". She looked up at me, and very reproachfully said, "You have not taught us the **Twig** function yet!"

These examples, together with many others, started me thinking about the underlying problems, that is, lack of mathematical ability and lack of confidence. Why do students carry out such totally wrong operations? How can I give them confidence in their mathematical ability and stop them treating the subject as one that they must inevitably fail? It is not unreasonable to expect this negative attitude to extend into any other subject that is mathematically orientated. So possibly finding a way to give students some confidence in their own ability in *College Algebra* may well help them substantially in other courses that involve mathematical concepts and operations.

After teaching the *spring 1995 College Algebra course*, it was clear that many students had created their own totally wrong set of rules. They had either remembered the rules of mathematics incorrectly or had never understood them in the first place. With this in mind, I created my *catchphrase* (on *Page 5*). On the first day of class, I use an overhead projector slide of *Page 5* and describe the cricketing exploits of *Bellarmine University's* first and only cricket team. The purpose is to emphasize the importance of learning the real rules of mathematics and reinforcing them by solving a large number of problems. Also, identifying the common problems among my students seems to decrease their Math anxiety. Later in my courses, when my students and I have become better acquainted, if I start to use the *catchphrase*, quite often some of my students will chant the rest of it back to me! Also they frequently write part of the catchphrase, such as "*Maths is fun*" on their assignments or tests (including the *s* on Math!). I now use my catchphrase in all my courses. It is also pinned on my office door.

From the spring of 1995 to the beginning of 1999, I created and tested a large number of different ideas that I refer to, collectively, as ***Special Techniques*** (I have never liked the word *techniques*, but I cannot think of a better one!). Some of the *techniques* were designed to reduce *Maths Anxiety*, some to give my students hope throughout the course, even after one or even two poor test marks, some to improve standards, and some were designed to optimize my time in the classroom. I also wanted to keep my students focused and interested during class and boost their mathematical confidence.

By the middle of 1999, I was using all of those *Special Techniques* that were judged successful, in my *M116 – Pre-Calculus* courses, my *M301 – Differential Equations* courses, as well as my *M105 – College Algebra* courses and they were working very well. However, while my students did talk to me, and the atmosphere in the classroom was far more relaxed and happier than before, they did not interact with each other very much and I thought that they would benefit if they did.

At the beginning of the summer of 1999, I remembered how much I had learned about Maths, when I marked my students' assignments and tests during my first few years of teaching. It occurred to me that if each student marked the work of another student, they might well benefit in a similar way. I thought that this strategy would make my students responsible for the progress of the other students on the course, because each student needs one of their partners to complete the assigned work, so that they can mark it and not lose any *marking marks*. However, the *marking marks* are independent of a student's ability, since the *marker* only has to recognize whether a question is correct or incorrect. I believe that *peer pressure* is the strongest force in the classroom, so I thought that this strategy would be very effective.

I now have my students working in threes (with some twos, when necessary). I call each group of students a ***partnership*** and each student in a *partnership* a **partner**. I select three sets of problems from the end of each section of the textbook that will be covered during the course. I call one set **Set A**, the second **Set B**, and the third **Set C**. The *partner* whose last name is nearest the beginning of the alphabet completes **Set A**. The next nearest the beginning of the alphabet completes **Set B**. The third, if there is one, completes **Set C**. If there are only two students in a partnership **Set C** is ignored. When a partner completes his or her own set of problems, they then mark the set of problems of ***ONE*** of their partners. They must then organize their work into ***one*** **joint workbook**. I call this strategy ***Peer Responsibility***. This strategy has had an amazing effect. There is nothing like *peer pressure* to get students working together! Note that in all of the courses I teach, 99% of the solutions and marking in the workbook is completed outside class time. While this is not necessary, I do it so that I have ample time to cover the concepts and complete related problems in class.

If all students in a partnership cannot do a question, I encourage them to talk to another partnership or come to me for assistance. Frequently, only one member of a partnership will come to me because the other partners are not free at the same time. In this case, I help this student and then he or she teaches the other partners. I have also arranged the marking scheme so that by talking to each other, students can stop their partners losing marks and help them obtain bonus marks. I felt that this approach would force students to interact, thereby maximizing student participation and student interaction. Many students have never marked the work of another student and even when they have they still have questions that need to be answered. When they have questions about marking the obvious person to ask is the instructor. This substantially increases student-instructor interaction.

During the summer of 1999, I developed strategies to deal with every possible situation that I thought could occur with *Peer Responsibility*. I then combined the *Special Techniques* and *Peer Responsibility* into one teaching methodology that I call **STAPRM**. **STAPRM** is an acronym for *Special Techniques* and *Peer Responsibility (Teaching) Method*. I say **STAPRM** as two syllables, the **STA** like the *sta* in the word *stack*, followed by *prom* for **PRM**. I started testing **STAPRM** on my students during the *Fall 1999 semester* in both my **M105 – College Algebra** and **M116 – Pre-calculus courses**.

Needless to say, in spite of my efforts, there were many situations that I had not foreseen!!! So, I had my students evaluate what I called at that time "*The Experiment*". Many students, including a number of older students, made some very useful comments, which allowed me to make improvements in time to use **STAPRM** in my *Spring 2000* **M301 – Differential Equations course**.

Completing the **workbook** gives my students the practice they need, which is absolutely essential in any Math course. This in turn improves the standard of their work and their understanding of the concepts. In view of this, the latest marking scheme makes completing the *workbook* essential. I have also found that this approach allows me to monitor each student's progress throughout the course very closely and far more easily than before. It has also bonded my students and I in a way that was unexpected and unforeseen before the term started. To get the best from this pedagogy, I developed a completely different style of teaching that maximizes the amount of time I have in the classroom to discuss the concepts and complete problems. It works best in a multimedia classroom, although if unavailable, I can, and very often have, managed without.

Peer Responsibility has had some unexpected bonuses. I had one student in my *College Algebra* class come up to me after a class and tell me that she had just finished marking her partner's work. She was very happy and excited about it. She ended with the comment "*Mary is as dumb as I am*!" At first sight, this does not sound too promising. However, when analyzed, what she is really saying is that she had realized for the first time that she is neither alone nor the worst student in the Math class. This made her feel better, which in turn reduced her anxiety about the course. Another bonus is the fact that since each partnership creates just one workbook, the students themselves monitor each other throughout the course, which reduces the possibility of cheating.

Parts of **STAPRM** have been designed to minimize the amount of time an instructor spends organizing the course. The following **Excel** files have been created to make keeping track of all the marks and grades as simple as possible

MarksRegisterAssignments#.xls
YourGradeAssignments.xls

where the # in the first file identifies a course uniquely. The file **MarksRegisterAssignments#** would be used by the instructor to keep track of the marks and grades of each student throughout the course. The file **YourGradeAssignments** would be used by each student to keep track of their own mark and grade throughout the course. While it is not essential to use these files, I would recommend using them because it will save time.

STAPRM is based on **5** methods of assessment ***during*** the semester, each worth **120 marks**, and a **Final** worth **400 marks**. These methods of assessment are listed below :

1)	**Assignments**	**120**
2)	**Workbook Solutions**	**120**
3)	**Workbook Marking**	**120**
4)	**Test 1**	**120**
5)	**Test 2**	**120**
6)	**Final**	**400**
	TOTAL MARKS FOR COURSE	**1000**

If the instructor of any course from any discipline creates assessments using the same format, both **MarksRegisterAssignments#** and **YourGradeAssignments** can be used. It is very simple to change the labels within each file so that they fit the selected assessment format.

After using **STAPRM** for over four years with over 350 students, their evaluations and reactions make it clear that it is a popular and successful teaching methodology. Good partner(s) can, and very often have, helped a less able student succeed in a course who would otherwise have failed. I have received comments at conferences from other instructors who are using **STAPRM** and each instructor has confirmed that **STAPRM** does achieve its goals. As the years have rolled relentlessly by, the age gap between my students and I has increased and it seemed as if this fact made my students less willing to come and see me. However, *Peer Responsibility* has had an amazing effect. It has caused my students and me to become united in a way I would never have thought possible. This has made the last few years some of the most exciting and fun-filled years I have had in over 30 years of teaching. In short, this pedagogy works! It reduces Math Anxiety, it gives students hope throughout the course and it maximizes student participation and student interaction with each other and with the instructor. At the same time, the practice in the workbook improves standards, and even better, it is clear that my students find *Peer Responsibility* ***fun*** - and so do I!

Since 1995, I have developed an evaluation form that asks my students to rate the *Special Techniques* and *Peer Responsibility* both numerically and with comments, while encouraging them to make suggestions. This form is now very comprehensive. Over the years, the numerical data and the comments about these strategies produced some surprises for me. In view of this, I have abandoned some of the techniques, because they did not achieve their objective, and refined others. I also modified both *Peer Responsibility* based on the numerical data and the comments I received. I deliberately created **STAPRM** so that it can be used by any teacher, and in any Mathematics course. Recently, colleagues have informed me that **STAPRM** can also be used in History, Education, Psychology, and Computer Science courses and in many other disciplines as well, not just Mathematics.

Incidentally, for some years I handed out the evaluation forms towards the end the class and then left the room without returning. Recently I discovered, if I teach for about 15 minutes (to ensure the stragglers have arrived), then hand out my forms, making it clear that I intend to continue teaching after they have completed them, I get far more useful information.

The purpose of this paper is to describe how to use this teaching methodology in the classroom. Chapter 2 describes how to introduce the *Special Techniques* into a course and the organization and structure of *Peer Responsibility*. The 23 techniques that form the *Special Techniques* are discussed in detail in Chapter 3. This chapter also describes the new style of teaching I developed to optimize my time in the classroom. *Peer Responsibility* is discussed in Chapter 4. Chapters 3 and 4 have been written so that each chapter is, as far as possible, independent of one another, so there is some duplication between Chapters 2, 3, and 4. An analysis of these strategies, based on the evaluations completed by my students, is in *Chapter 5*. The cost of implementing this teaching methodology is discussed in *Chapter 6*, with a conclusion in *Chapter 7*. All the courses discussed within this paper are Mathematics courses because I teach Mathematics courses. All essential files that an instructor would need to use this methodology are available ***FREE OF CHARGE*** via the Internet.

MY CATCHPHRASE IS :

MATHS IS FUN

BECAUSE

MATHS IS EASY

IF

YOU KNOW THE

RULES

AND

PRACTICE

To emphasize the "*Rules and Practice*" part of my catchphrase, I use a number of true stories involving cricket. For example, in 1989 I went with a number of faculty and a group of Bellarmine students to Oxford University, England. We were going to complete some courses over there and sightsee at the same time. Before we went, I knew that students from Ohio State University would be there for their summer school and, at some point, Bellarmine and Ohio State would play cricket against each other.

For some three months before going over, I taught our Bellarmine students the rules of cricket and had them practicing against each other. However, all the Ohio State students were new to the game and did not know that our students had played before. They made all the usual mistakes that Americans make when playing cricket. For example, I had taught my students to make sure the cricket ball, which is about the same size and weight as a baseball, bounced BEFORE it got to the batsman. Americans are not used to this. Unknowingly the Ohio State students hurled the ball at our batsman as fast as they could at about waist height, *BUT* a cricket bat is about four inches wide and *FLAT*. Our Bellarmine students thought Christmas had come early! They amused themselves trying to blast the ball into orbit!!! Bellarmine wiped the floor with Ohio State, it was a massacre!! Why, because my students knew the rules and had practiced! When I tell my students that there is a Maths Test next week and ask them what they are going to do, they know the answer -

KNOW THE RULES AND PRACTICE!

2. HOW TO USE STAPRM IN A COURSE

The objective of this chapter is to provide an instructor with the information needed to start using **STAPRM** in any course. It is divided into the following three main sections :

2.1 The Semester Plan and the Three Sessions
2.2 Using the Special Techniques in a Course
2.3 Using Peer Responsibility in a Course

If **Peer Responsibility** is used in a course, then all students need a copy of the set of notes called "*A Guide to Partnerships*". For brevity, I reference this set of notes throughout this paper with the word *Guide*. Since, in my experience, students will not read the *Guide* unless they are forced to, I would also recommend that all students take the **Structure Test**. This is an open-book test. When they take it, I always allow them to refer to a copy of the *Guide* throughout the test. The *Structure Test* is the only test in this course that I allow students to take if they are absent on the day of the test or, if they add the class too late to take it with the other students. Students can copy the *Guide* from my computer area. I never copy it for them. Additional information and recommendations about the *Guide* and the *Structure Test* are included in *Chapter 4* of this paper.

I would also recommend using the Excel worksheet "*QuestionsForTheWorkbook*". This worksheet lists the questions to be completed in the workbook. Other methods of providing students with the sets of questions to be completed in the workbook are discussed in *Chapter 4* of this paper.

The *Guide*, the reference version of the *Structure Test*, and the *QuestionsForTheWorkbook* sheet can be copied from this paper (of course, the answers and the section references would have to be erased from the *Structure Test*). Alternatively computer copies of these files, including the student version of the *Structure Test*, can be obtained from my web site. The *Guide* and the *Structure Test* are **Word** files. These two files are identical for all courses in which *Peer Responsibility* is used. The *Questions for the Workbook* is an **Excel** file. The format of this file will be the same in every course, but the section and question numbers will be different from course to course. The file names of each of these documents are shown below :

AGuideToPartnerships.doc
StructureTestStudentVersion.doc
QuestionsForTheWorkbook#.xls

where the **#**, in the last file, identifies a course uniquely. I usually replace the **#** in this type of file with the department letter and course number only. For example, *QuestionsForTheWorkbookM205.xls,* where the M is for the Mathematics department and 205 is the course number in the catalog for Elementary Statistics.

This teaching methodology has been designed to be flexible, so that any instructor can put his or her own identity on it and to minimize the amount of time an instructor spends organizing the course, so that he or she has more time to spend teaching and interacting with the students. The following **Excel** files have been created to make keeping track of all the marks and grades as simple as possible

MarksRegisterAssignments#.xls
YourGradeAssignments.xls

where the **#** in the first file identifies a course uniquely. I usually replace the **#** in this type of file with each of the following :

1) the semester – S or F (S for spring, F for Fall);
2) the year;
3) M for Maths, followed by the catalog course number and letter(s);
4) the length of each session (see Section 2.1).

For example, *MarksRegisterAssignmentsS2002M105N554.xls,* where S is spring, 2002 the year, M for Maths, 105 is the course number in the catalog for College Algebra, N represents the class time, and 554 indicates that there are 5 weeks in Sessions 1 and 2, and 4 weeks in Session 3 (each semester is divided into three sessions. They are discussed in Section 2.1).

The file with file name **MarksRegisterAssignments#.xls** would be used by the instructor. It keeps track of the marks and grades of each student in a class throughout a course. It is discussed in full in Section 2.3.3. The file with file name **YourGradeAssignments.xls** would be used by a student to keep track of his or her marks and grades throughout the course. It is discussed in full in Section 2.3.4. The instructor does not have to use either file, however, I use both files in every course because they save a lot of my time.

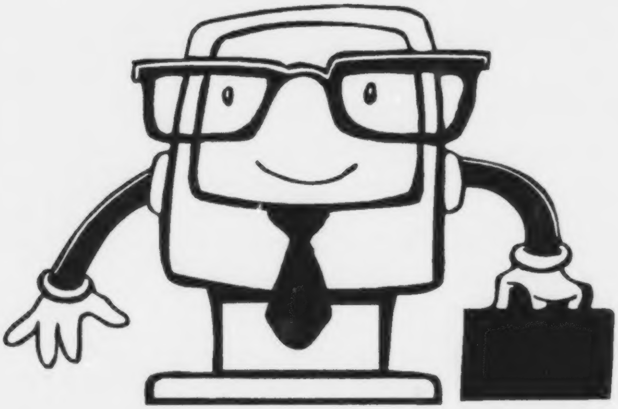
It is not necessary to use the files

TimesNotAvailableForm.doc
or
ThreeWeekPartnershipReportForm

in a course. However, I always do, because after testing various ideas over a number of semesters, these forms solved the problems best. The first file gets students into partnerships quickly on the first day of class and the second provides feedback to each partnership at the end of the third week of the course. Both forms are discussed, with examples, in the next section (Section 2.3.1).

A **Semester Plan** is one sheet of paper with all the important dates on it i.e. dates when the workbook must be handed in, when assignments are due etc. An example of a Fall Semester plan is on page 10 and an example of a Spring Semester plan is on page 11. It is not necessary to use a Semester Plan in a course, however, once again, I always do, because my students have repeatedly told me how useful it is. Semester Plans are discussed, with examples, in the next section (Section 2.3.1).

Note that all parts of this paper and all related **Word** and **Excel** files are available ***free of charge*** to anyone who wishes to use part or all of the teaching methodology described in this paper. Feel free to pass all, or any part of, this paper or any Word and/or Excel file on to a colleague(s).



2.1 The Semester Plan and the Three Sessions

Semester Plans list all the important dates associated with each type of assessment, for an entire 15-week semester plus Finals week, on one sheet of paper. There are two sets of *Semester Plans*, a fall set and a spring set. This is necessary because Spring Break makes all spring *Semester Plans* one week longer than fall Semester Plans. When the session lengths in a semester are the same, all fall *Semester Plans* are identical and all spring *Semester Plans* are identical (sessions are discussed later in this section). Creating a new *Semester Plan* from an existing one usually takes less than 10 minutes.

The weekday dates in all Semester Plans are set ***relative*** to the first Monday of the semester. Changing the date of the first Monday of the semester will correctly set all the weekday dates throughout the semester. The Monday of the first week of the Spring 2003 semester is the 6th January, 2003 (*Cell Content = 01/06/2003*). The Monday of the first week of the Spring 2004 semester is the 5th January, 2004 (*Cell Content = 01/05/2004*). If the 6th January, 2003 is changed to 5th January, 2004, then all the dates throughout the semester will be set correctly for the Spring 2004 semester, with February 29th included, since 2004 is a leap year.

I have found *Semester Plans* so useful that I use them in every course I teach and I always include a black and white copy of the relevant Semester Plan in each syllabus. I tell my students to remove it from the syllabus and keep it handy throughout the course. I also put a copy of each Semester Plan in my computer area. Many of my students have stated that they like having all the important dates, for an entire semester, listed on one sheet of paper, and make a color copy of the Semester Plan from my computer area. I include an example of a *Fall Semester Plan* on page 10 and a *Spring Semester Plan* on page 11.

In each Semester Plan, the date at the top of the worksheet, the second row, and the two (sometimes three) rows of cells immediately under the weekday and date are ***not*** write-protected. So their content can be changed without the need to unprotect the worksheet. All the other cells are write-protected so that the dates, which are formulae, cannot be overwritten accidentally. To add or delete rows (or columns) or change the content of any protected cell, the worksheet must first be unprotected. To unprotect the worksheet, select

Tools/Protection/Unprotect Sheet

To re-protect the work sheet, select

Tools/Protection/Protect Sheet/OK.

Due to the workbook (*Peer Responsibility*), each Semester is divided into three parts, so that my students can obtain feedback about the work in their workbooks before each test throughout the semester. I call the three parts *Session 1*, *Session 2*, and *Session 3*. They are shown in each *Semester Plan*. At the end of each session, I collect the workbooks and mark the solutions in the same way as I mark the solutions on the tests, so that students can see how I mark and also how to gain bonus marks. I also mark the marking. I then return the workbooks before each test is taken. *Session 3* usually ends at the end of the 14th week, instead of the end of the semester, in order to provide feedback to my students before the **Final**, and to give me time to write the finals!

In order to stagger the marking during each semester I use Sessions of different lengths. Four schemes are shown in the table on the next page. Many others schemes are possible. I usually teach four courses per semester, two *Statistics courses* and two other Mathematics courses. I use **Scheme 1** for one Maths course, **Scheme 2** for the second Maths course, **Scheme 3** for one of my *Statistics courses* and **Scheme 4** for the other Statistics course. The numbers in brackets under the scheme number, indicate the length of each of the three sessions in weeks.

This teaching methodology is very robust. By that I mean, when something goes wrong or changes are needed, adjustments can be made very easily and very quickly. For example, at the beginning of the Spring 2003 semester my *M301 – Differential Equations* course was set up as a 455 course i.e. *Session 1 = 4 weeks, Session 2 = 5 weeks, Session 3 = 5 weeks* (Scheme 1 below). Unfortunately, one week of the course was lost within the first three weeks of the semester because I went to the Joint Mathematics Meetings for three days and a two hour class fell on Martin Luther King's holiday. However, it took less than 10 minutes to change the Semester Plan to a 653 (Scheme 4 below) and have the three week reports at the end of the fourth week.

SCHEME 1 **(455)**	**SCHEME 2** **(454)**	**SCHEME 3** **(554)**	**SCHEME 4** **(653)**
SESSION 1	SESSION 1	SESSION 1	SESSION 1
WEEK 1	WEEK 1	WEEK 1	WEEK 1
WEEK 2	WEEK 2	WEEK 2	WEEK 2
WEEK 3	WEEK 3	WEEK 3	WEEK 3
WEEK 4	WEEK 4	WEEK 4	WEEK 4
SESSION 2	SESSION 2	WEEK 5	WEEK 5
WEEK 5	WEEK 5	SESSION 2	WEEK 6
WEEK 6	WEEK 6	WEEK 6	SESSION 2
WEEK 7	WEEK 7	WEEK 7	WEEK 7
WEEK 8	WEEK 8	WEEK 8	WEEK 8
WEEK 9	WEEK 9	WEEK 9	WEEK 9
SESSION 3	SESSION 3	WEEK 10	WEEK 10
WEEK 10	WEEK 10	SESSION 3	WEEK 11
WEEK 11	WEEK 11	WEEK 11	SESSION 3
WEEK 12	WEEK 12	WEEK 12	WEEK 12
WEEK 13	WEEK 13	WEEK 13	WEEK 13
WEEK 14		WEEK 14	WEEK 14

NOTE : Sessions and schemes are only needed, if *Peer Responsibility* is being used in a course.

At the end of each session or at any other time during the course, students can copy the **Excel** workbook ***YourGradeAssignments.xls*** from my computer area onto a zip disk or a floppy disk, open it in **Excel**, and use it to calculate their mark and grade. It also allows my students to ***forecast*** the grade they will need in the Final to obtain the grade they want for the course. The first worksheet in this workbook is the instructions for using the ***Your Grade*** worksheet. It is displayed on page 35. The ***YourGrade*** worksheet is shown on page 36. They are discussed in *Section 2.4*. A copy of it is available via the Internet.

FALL 2002 SEMESTER PLAN ASSIGNMENTS 653

M405N - INTRODUCTION TO NUMERICAL ANALYSIS : TTh - 8:00 to 9:15

WK	SESSION 1				
1	Monday 26-Aug	Tuesday 27-Aug	Wednesday 28-Aug	Thursday 29-Aug	Friday 30-Aug
		Copy "*Guide*" Find Partners			
2	Monday 2-Sep	Tuesday 3-Sep	Wednesday 4-Sep	Thursday 5-Sep	Friday 6-Sep
	LABOUR DAY	**STRUCTURE TEST** (Buy a Red Pen!)			
3	Monday 9-Sep	Tuesday 10-Sep	Wednesday 11-Sep	Thursday 12-Sep	Friday 13-Sep
		Copy Example Test 1		Workbook Due (Is Work Complete?)	
4	Monday 16-Sep	Tuesday 17-Sep	Wednesday 18-Sep	Thursday 19-Sep	Friday 20-Sep
		Workbook Returned		A1 and A2 Set	
5	Monday 23-Sep	Tuesday 24-Sep	Wednesday 25-Sep	Thursday 26-Sep	Friday 27-Sep
		Copy "*YourGrade*"			Withdraw 75%
6	Monday 30-Sep	Tuesday 1-Oct	Wednesday 2-Oct	Thursday 3-Oct	Friday 4-Oct
		Wb Two-Day Rule A1 and A2 Due		Workbook Due A1 and A2 Returned	
	SESSION 2				
7	Monday 7-Oct	Tuesday 8-Oct	Wednesday 9-Oct	Thursday 10-Oct	Friday 11-Oct
		Workbook Returned		**TEST 1**	
8	Monday 14-Oct	Tuesday 15-Oct	Wednesday 16-Oct	Thursday 17-Oct	Friday 18-Oct
		TEST 1 RETURNED		Copy Example Test 2 Use "YourGrade"	
9	Monday 21-Oct	Tuesday 22-Oct	Wednesday 23-Oct	Thursday 24-Oct	Friday 25-Oct
	FALL BREAK			A3 and A4 Set	Withdraw 50%
10	Monday 28-Oct	Tuesday 29-Oct	Wednesday 30-Oct	Thursday 31-Oct	Friday 1-Nov
					Last Day to Withdraw
11	Monday 4-Nov	Tuesday 5-Nov	Wednesday 6-Nov	Thursday 7-Nov	Friday 8-Nov
		Wb Two-Day Rule A3 and A4 Due		Workbook Due A3 and A4 Returned	
	SESSION 3				
12	Monday 11-Nov	Tuesday 12-Nov	Wednesday 13-Nov	Thursday 14-Nov	Friday 15-Nov
		Copy Example Final A5 and A6 Set		**TEST 2**	
13	Monday 18-Nov	Tuesday 19-Nov	Wednesday 20-Nov	Thursday 21-Nov	Friday 22-Nov
		TEST 2 RETURNED Use "YourGrade"		Wb Two-Day Rule A5 and A6 Due	
14	Monday 25-Nov	Tuesday 26-Nov	Wednesday 27-Nov	Thursday 28-Nov	Friday 29-Nov
		Workbook Due A5 and A6 Returned	**THANKSGIVING HOLIDAY**		
	END OF WORKBOOK				
15	Monday 2-Dec	Tuesday 3-Dec	Wednesday 4-Dec	Thursday 5-Dec	Friday 6-Dec
		Workbook Returned		Forecast Final Mark Using "YourGrade"	
	FINALS WEEK				
M J B	Monday 9-Dec	Tuesday 10-Dec	Wednesday 11-Dec	Thursday 12-Dec	Friday 13-Dec
	M205BO : 8:00 - 11:00		**M205CO : 8:00 - 11:00**	**M405N : 8:00 - 11:00**	

SPRING 2003 SEMESTER PLAN ASSIGNMENTS 653

M301DO - Differential Equations : M - 12:00 to 1:50; WF - 12:00 to 12:50

WK	SESSION 1				
1	Monday 6-Jan Copy "*Guide*" Find Partners	Tuesday 7-Jan	Wednesday 8-Jan	Thursday 9-Jan	Friday 10-Jan
2	Monday 13-Jan **STRUCTURE TEST** (Buy a Red Pen!)	Tuesday 14-Jan	Wednesday 15-Jan **CONFERENCE**	Thursday 16-Jan	Friday 17-Jan
3	Monday 20-Jan **MARTIN LUTHER KING**	Tuesday 21-Jan	Wednesday 22-Jan	Thursday 23-Jan	Friday 24-Jan
4	Monday 27-Jan	Tuesday 28-Jan	Wednesday 29-Jan Copy Example Test 1 Set A1 and A2	Thursday 30-Jan	Friday 31-Jan Workbook Due (Is Work Complete?)
5	Monday 3-Feb Workbook Returned Intro "*YourGrade*"	Tuesday 4-Feb	Wednesday 5-Feb	Thursday 6-Feb	Friday 7-Feb Withdraw 75%
6	Monday 10-Feb	Tuesday 11-Feb	Wednesday 12-Feb Wb Two-Day Rule A1 and A2 Due	Thursday 13-Feb	Friday 14-Feb Workbook Due A1 and A2 Returned
	SESSION 2				
7	Monday 17-Feb Midterm Reports Due	Tuesday 18-Feb	Wednesday 19-Feb **TEST 1**	Thursday 20-Feb	Friday 21-Feb
8	Monday 24-Feb **TEST 1 RETURNED** Use "*YourGrade*"	Tuesday 25-Feb	Wednesday 26-Feb	Thursday 27-Feb	Friday 28-Feb
9	Monday 3-Mar	Tuesday 4-Mar	Wednesday 5-Mar Copy Example Test 2 Set A3 and A4	Thursday 6-Mar	Friday 7-Mar Withdraw 50%
	Monday 10-Mar **SPRING BREAK**	Tuesday 11-Mar	Wednesday 12-Mar	Thursday 13-Mar	Friday 14-Mar
10	Monday 17-Mar	Tuesday 18-Mar	Wednesday 19-Mar	Thursday 20-Mar	Friday 21-Mar
11	Monday 24-Mar	Tuesday 25-Mar	Wednesday 26-Mar Wb Two-Day Rule A3 and A4 Due	Thursday 27-Mar	Friday 28-Mar Workbook Due A3 and A4 Returned
	SESSION 3				
12	Monday 31-Mar Workbook Returned	Tuesday 1-Apr	Wednesday 2-Apr **TEST 2**	Thursday 3-Apr	Friday 4-Apr
13	Monday 7-Apr **TEST 2 RETURNED** Use "*YourGrade*"	Tuesday 8-Apr	Wednesday 9-Apr Copy Example Final Set A5 and A6	Thursday 10-Apr	Friday 11-Apr
14	Monday 14-Apr Wb Two-Day Rule	Tuesday 15-Apr	Wednesday 16-Apr Workbook Due	Thursday 17-Apr **EASTER**	Friday 18-Apr
	END OF WORKBOOK				
15	Monday 21-Apr **EASTER**	Tuesday 22-Apr	Wednesday 23-Apr A5 and A6 Due Workbook Returned	Thursday 24-Apr	Friday 25-Apr A5 and A6 Returned Use "*YourGrade*"
	FINALS WEEK				
M J B	Monday 28-Apr **M205BN : 8:00 - 11:00** **M301DO : 12:00 - 3:00** **M301 Final Prac Due**	Tuesday 29-Apr	Wednesday 30-Apr	Thursday 1-May	Friday 2-May **M205AN : 8:00 - 11:00**

2.2 USING THE SPECIAL TECHNIQUES IN A COURSE

Twenty-three techniques form the *Special Techniques*. A full description of each technique, with additional comments based on my experiences using them, is in Chapter 3. Techniques *9* and *12* are to do with *Peer Responsibility*. Since this is discussed in Chapter 4, I will only consider the remaining 21 in this section.

When using the *Special Techniques* for the first time, I would not recommend attempting to use all 21 immediately. Steps 1, 2, and 3, below describe how to incorporate the *Special Techniques* into any course. The numbers at the end of the technique indicate the rank that each technique obtained in my student evaluation forms. A copy of one of these forms is included in Chapter 5.

Step 1

Initially, I would recommend using *Techniques 2, 3, 4, 5, 6, 10, 11* and *14*. They are listed below with comments where appropriate.

2) *Provide an Example Test Before Each Real Test (Including the Final)* - ***1st (ALWAYS!)***

I would recommend this technique because it has always been first in the evaluations completed by my students. The first time I provided Example Tests, I put the tests I had used the previous semester into my computer area and told my students to make copies of them. This required very little effort on my part but this technique has always been ranked number one by my students on every evaluation form. Now I use *Peer Responsibility* in all my courses, my Example Tests are more elaborate and longer than before. I write each Example Test so that it covers all the topics in a session. I then tell my students to divide the questions on the Example Test among the partners then complete and discuss them. I do not mark questions on any Example Test, although I do answer all questions about them. The workbook acts like a catalyst and gets students working together. Students are then very willing to work together on the Example Tests. I usually use Example Tests for 3 or 4 semesters before I modify them.

I recommend the following techniques because they require no additional effort on the part of the instructor but my students have ranked them in the top 10.

3) *No Time Limit on Tests, Including the Final (as far as possible)* - ***3rd***

4) *Take One Sheet of Paper into a Test Including the Final* - ***2nd***

It is very important that you read the discussion about this technique in Chapter 3, *BEFORE* you use it.

5) *All Questions on the Tests Straight from or Similar to Questions in the Textbook or on the Example Test* - ***Joint 4th***

My students really like this technique and it has saved me an enormous amount of time over the years, because I do not have to invent questions any more and the solutions are in the instructor's solution manual. Sometimes I do shorten questions to reduce the time it takes to complete them.

6) ***Never*** *Require Students to Remember Formulae* ***BUT*** *Must Know* ***When*** *to Use a Formula and, If the Formula has been Forgotten, Must Know Where to Find It* - ***7th***

10) *90% or More in Final Rule for Eligible Students (Provided* ***ALL*** *Assignments and Workbook Complete)* - ***8th***

If you use this rule your Final needs to be demanding or you will have every student in the class obtaining an **A**!

11) *Top 25% in Final Rule for Eligible Students (Provided* ***ALL*** *Assignments and Workbook Complete)* ***9th***

If a student, who is not an **A** student prior to the Final, obtains a mark in the top 25% of the class, they will earn an **A** for the ***course***. In my view, if they beat some of the top students in the class, they deserve an **A**! Clearly this percentage can be adjusted up or down as appropriate. **See the notes in Chapter 3 *BEFORE* you use it.**

I recommend using *Technique 14*, shown below, because the evaluations have made it clear that it is very important to some students. The evidence that I have gathered indicates that showing students the errors made by students in the past, does stop some students from making some of the same errors on tests in the future. Sometimes, when I am solving a question, I ask my students what possible error could be made in the question. This can, and frequently has, generated some very useful discussion with many students participating. I think that this technique should be started at the beginning of every course.

14) Showing Students Errors Made by Students in Previous Courses - ***14th***

Step 2

I believe the next step should involve some of those techniques designed to give the instructor more time to interact with your students. *Techniques 16* and *17* are timing consuming to prepare initially, however, they do achieve their goals. I have been teaching *College Algebra*, *Statistics*, *Differential Equations*, and *Numerical Analysis* for many years, so the overhead projector slides I have created and improved over the years get used over and over again. This gives me more time to interact with my students without requiring any more of my own time. *Technique 18* is very easy to implement and although my students ranked it 16th, the comments I have received suggest that it has a very positive effect in the classroom. These three techniques are listed below. A detailed description of each is included in Chapter 3.

16) Use Textbook as a Set of Notes to Minimize the Amount of Writing Students Do In Class - ***Joint 11th***

17) Make and Use Transparencies of Graphs, Tables, Rules, etc. So Time is Not Wasted Drawing or Writing Them on the Blackboard - ***12th***

18) Use Colored Chalk or Colored Markers on the Board - ***16th***

I was surprised to find that my students ranked *Technique 23*, shown below, 5th overall. If you will be using a **TI-83** for the course, this is a good technique to use because it is very simple for both the instructor and the students to use.

23) Using a *Metalanguage* with the **TI-83** Calculator - ***5th***

Step 3

I have had a number of very positive comments about *Technique 13*, below, even though it is always ranked last by most students. I use it in every course because I believe it is academically important. I started to use it after I discovered that I was giving a lot of marks to students who knew which buttons to press on the **TI-83** calculator, but did not know the meaning of the number on their display screen.

13) Any Numerical Answer Requires a Sentence Containing the Number in the Context of the Question - ***Absolutely Last as Always!***

The remainder of the techniques can be included in a course as and when the instructor is ready to use them.

2.3 USING PEER RESPONSIBILITY IN A COURSE

If an instructor uses Peer Responsibility in any course then each student ***MUST*** have the set of notes called "*A Guide to Partnerships*" because it provides full details about *Peer Responsibility*. It is a ***Word*** file with filename **AGuideToPartnerships.doc**. It is discussed in *Chapter 4*. I ***NEVER*** duplicate this file for my students. I put a copy of it into my computer area and then, on the first day we meet, I tell my students to make a copy it.

In my experience, students will not read the *Guide* unless they are ***made*** to read it, and since understanding *Peer Responsibility* is so important, I give all my students a test about it at the beginning of the second week of the semester. I call this test the *Structure Test* (I use the acronym **ST**). The *Structure Test* is an open book test i.e. they can use the *Guide* while taking the test. Indeed the questions in the test are numbered to make a student start on page 1 of the *Guide* and go page by page through the *Guide*. I would urge anyone, who uses *Peer Responsibility* in a course, to give the test on the *Guide* to all students taking the course. It will save a lot of mistakes later on!

The *Structure Test* contains 20 multiple-choice questions. The filename of the students' version of the test is **StructureTestStudentVersion**. The answers to the *Structure Test* together with references to the *Guide* are in the file with filename **StructureTestReferenceVersion**. This file is included in *Chapter 4*. I make it clear to all my students that the *Structure Test* is worth 20 *bonus* marks, one mark per correct question, on a 1000-mark scale. Therefore every student in the class could start the course with a *20-mark credit*.

They must complete the test in **pencil** by circling one of the letters a, b, c, or d for each question. After the test has been completed, students exchange tests with the appropriate partner who must mark it with a **red** pen in accordance with the instructions in the *Guide*. Any student who does not have a **red** pen ***loses*** **5 marks**. After the tests are marked and each student has made a note of their own mark, the tests are then passed to me, so that I can record all the marks. I do not return the tests to my students. I ***do*** allow any student who misses this test to make it up, because I want every student to understand *Peer Responsibility*. However, there are no *make-up tests* for *Test 1* and *Test 2* in any course of mine (the lost marks are added to the mark for the Final).

Throughout each session, including *Session 1*, I deduct at least 1 mark for incorrect marking (maximum 4). I have found that most students are careful to follow the *Guide*, in spite of the fact that it is 10 pages long! In Sessions 2 and 3, it is rare for a student *not* to follow the *Guide* correctly because they know that if they do not, they will lose marks. It is a joy having students who are familiar with *Peer Responsibility* taking another course with me because they teach the other students about it.

It is important to get all students into partnerships as soon as possible. I always do this on the first day we meet. The methods I use are discussed in ***Section 2.3.1***. Selecting Questions for **Set A**, **Set B**, and **Set C** is also very important. This is discussed in ***Section 2.3.2***. If *Peer Responsibility* is used in any course, there are two ***Excel workbooks*** that I believe are essential because they save the instructor so much time. The file **MarksRegisterAssignments#**, where the **#** represents a course uniquely, allows the instructor to keep track of the marks and grades of each student in a class, throughout the course. This is discussed in ***Section 2.3.3***. The file **YourGradeAssignments** allows each student to keep track of their own marks and grades throughout the course. This file is the same for every course involving assignments. It is discussed in **Section 2.3.4**.

The *Guide*, the student version of the *Structure Test*, *SemesterPlanFall#*, *SemesterPlanSpring#*, *MarksRegisterAssignments#*, and *YourGradeAssignments* are on my web site. There are also some example Semester Plans, some for the Fall semester and some for the Spring semester, and a sample *Marks Register* and *Attendance Register*. The *Attendance Register* is a worksheet in the same workbook as the Marks Register. Note that all the names and the marks in the sample Marks Register and Attendance Register have been invented.

2.3.1 Forming Successful Partnerships

One of the most common complaints I used to get from my students was that they could not meet their partners because they were not available at the same time. To solve this problem I use a one-page form I call the *Times Not Available Form*. It is a **Word** file with filename **TimesNotAvailableForm**. I distribute a copy of it on the first day of class. Then, while I am taking the register, my students fill it out and look for other students whose free time coincides as much as possible with their own free time. The objective of using this one sheet is to get all my students seated together, as quickly as possible, in partnerships that will work well together. This one page file is shown on the next page. I am always amazed at how quickly a large class of students get themselves seated in partnerships of threes (with some twos, if necessary), with no help from me at all. On one occasion, my students had filled out their forms, when I realized that I had left something in my car. I told my students to find their partners while I went to my car and when I returned just a few minutes later; they were all sitting in their partnerships ready to start work!

INSTRUCTIONS : **CROSS OUT ALL THE TIMES DURING THE WEEK WHEN YOU CANNOT MEET YOUR PARTNER**

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
8:00 am – 9:00 am	8:00 am – 9:00 am	8:00 am – 9:00 am	8:00 am – 9:00 am	8:00 am – 9:00 am	8:00 am – 9:00 am	8:00 am – 9:00 am
9:00 am – 10:00 am	9:00 am – 10:00 am	9:00 am – 10:00 am	9:00 am – 10:00 am	9:00 am – 10:00 am	9:00 am – 10:00 am	9:00 am – 10:00 am
10:00 am – 11:00 am	10:00 am – 11:00 am	10:00 am – 11:00 am	10:00 am – 11:00 am	10:00 am – 11:00 am	10:00 am – 11:00 am	10:00 am – 11:00 am
11:00 am – 12:00 pm	11:00 am – 12:00 pm	11:00 am – 12:00 pm	11:00 am – 12:00 pm	11:00 am – 12:00 pm	11:00 am – 12:00 pm	11:00 am – 12:00 pm
12:00 pm – 1:00 pm	12:00 pm – 1:00 pm	12:00 pm – 1:00 pm	12:00 pm – 1:00 pm	12:00 pm – 1:00 pm	12:00 pm – 1:00 pm	12:00 pm – 1:00 pm
1:00 pm – 2:00 pm	1:00 pm – 2:00 pm	1:00 pm – 2:00 pm	1:00 pm – 2:00 pm	1:00 pm – 2:00 pm	1:00 pm – 2:00 pm	1:00 pm – 2:00 pm
2:00 pm – 3:00 pm	2:00 pm – 3:00 pm	2:00 pm – 3:00 pm	2:00 pm – 3:00 pm	2:00 pm – 3:00 pm	2:00 pm – 3:00 pm	2:00 pm – 3:00 pm
3:00 pm – 4:00 pm	3:00 pm – 4:00 pm	3:00 pm – 4:00 pm	3:00 pm – 4:00 pm	3:00 pm – 4:00 pm	3:00 pm – 4:00 pm	3:00 pm – 4:00 pm
4:00 pm – 5:00 pm	4:00 pm – 5:00 pm	4:00 pm – 5:00 pm	4:00 pm – 5:00 pm	4:00 pm – 5:00 pm	4:00 pm – 5:00 pm	4:00 pm – 5:00 pm
5:00 pm – 6:00 pm	5:00 pm – 6:00 pm	5:00 pm – 6:00 pm	5:00 pm – 6:00 pm	5:00 pm – 6:00 pm	5:00 pm – 6:00 pm	5:00 pm – 6:00 pm
6:00 pm – 7:00 pm	6:00 pm – 7:00 pm	6:00 pm – 7:00 pm	6:00 pm – 7:00 pm	6:00 pm – 7:00 pm	6:00 pm – 7:00 pm	6:00 pm – 7:00 pm
7:00 pm – 8:00 pm	7:00 pm – 8:00 pm	7:00 pm – 8:00 pm	7:00 pm – 8:00 pm	7:00 pm – 8:00 pm	7:00 pm – 8:00 pm	7:00 pm – 8:00 pm
8:00 pm – 9:00 pm	8:00 pm – 9:00 pm	8:00 pm – 9:00 pm	8:00 pm – 9:00 pm	8:00 pm – 9:00 pm	8:00 pm – 9:00 pm	8:00 pm – 9:00 pm
9:00 pm – 10:00 pm	9:00 pm – 10:00 pm	9:00 pm – 10:00 pm	9:00 pm – 10:00 pm	9:00 pm – 10:00 pm	9:00 pm – 10:00 pm	9:00 pm – 10:00 pm

If an instructor intends to use *Peer Responsibility* I would certainly recommend using this form to get a class of students seated together in partnerships. I have tried many different methods over the years and, so far, this form is the best. Depending on the number of students in a class, there may have to be one or even two partnerships of two. Note that if the number of students in a class is exactly divisible by three, then I take two of the threes and divide them into three partnerships of two. The reason for this is that if a student adds the course, I have somewhere to put him or her.

When partnerships do collapse – and they do and will, I have found that students are very willing to help each other. Earlier in the spring 2000 term, two students lost their partner's, so I put them together, however, both students had completed the **Set A** questions. So they would have marked the same set of questions that they had completed. I told them that this would not be a problem because I had a set of **Set B** solutions that could be marked and they could switch at the beginning of the next session. However, one of the students volunteered to solve the **Set B** questions, so that the other, had a different set of questions to mark, and in spite of my assurances that she did not have to do it, she went ahead and did it anyway! Another example of just how willing students are to help each other occurred in Spring 2000 *Differential Equations course*. One of my students dropped a few weeks before the end of the course. However, *she still completed her own questions so that her partner could get his marking marks*. This really did surprise me, even after several years of experience with this teaching methodology.

If a student does need a set of questions to mark so they do not lose any marking marks, I make two copies of the completed section(s) that is needed from the workbook of a successful partnership (the student who needs to mark a section(s) does not know who completed them). I then cover all the marking (and name, if necessary), using ***Wite Out*** or white stick-ons on one of the copies, copy this and let the student who has lost their partner mark this set of questions. I can mark this section(s) very quickly from the unchanged copy of the marked section(s). This sounds like a bit of a performance, however, it does not take very long to prepare a set of questions. Also I keep copies of the fully marked section(s) and the *Wite Out* section(s), in case I need it later in the course or when the course runs again. This procedure also solves the problem of a student adding after three or four weeks of the course.

The *Times Not Available Form*, on the previous page, merely gets all students into partnerships. There are no guarantees that these partnerships are going to work. In reality I have found that about 75% of the partnerships formed using the form remain intact. The others need to be re-arranged. This percentage increases as the number of students in a class, who have experienced Peer Responsibility, increases. I try to head off a possible problem before it gets out of hand. At the end of *Week 3*, I collect the workbooks and check to see if my students have completed and marked all the assigned questions - ***I do not mark them***. I provide each partnership with a report using the form on the next page. The file name of this form is **ThreeWeekPartnershipReportForm**. If necessary, I re-arrange those partnerships that are not functioning correctly. My philosophy is simple. I leave students who have completed and marked all the assigned questions together. I refer to these students as *workers*. I reassign partners who are behind, depending on how much of the workbook they have completed. I refer to these students as *non-workers*. I also re-arrange partnerships so that students who attend form partnerships, and students who do not attend or do not follow the rules in the guide, form partnerships. **In short**,

1) I put the *workers* together;

2) I put the *non-workers* together;

3) I put students who *miss class* and/or do ***NOT follow the rules*** together (Note that I have found that putting students who miss class together in pairs ***NOT*** in threes is more effective).

The above three categories are defined in the *Guide*. I also make it clear in the *Guide* that each student can choose to be in any one of these three categories and that they will gain the most academically and obtain the highest grade, by being a *worker* in a partnership with other *workers*. I permit one exception. If all the partners in a partnership request to stay together, then I leave them together, even if one is way behind. What I have found interesting is that the students themselves hassle each other to complete the work because one student's marking marks depend on the other completing the questions. *I have found that peer pressure is far more effective than anything that I can say or do.*

21

THREE – WEEK PARTNERSHIP REPORT

JOINT WORKBOOK PRESENTATION	

SET A	SOLVER	
	MARKER	

SET B	SOLVER	
	MARKER	

SET C	SOLVER	
	MARKER	

The second common complaint about a partner is that they cannot get him or her to do the work. I have solved this problem in the marking scheme. A student could lose up to **4 marks** for each calculation or comment in a question or part of a question that is incorrect, incomplete, or omitted. Far more important, if a student does not bother to complete all of his or her solutions for any reason, the *Guide* explains to a *marker*, how to ensure that he or she does not lose any marking marks.

Quite frequently I have had one or two good students in a partnership with one less able student. One or both of the good students have commented that they were not concerned about poor solutions from the less able student because when marking them, they only have to recognize whether a calculation or comment was correct or incorrect. Not only has this type of partnership worked very well, the good student(s) frequently helped the less able student obtain a better grade than he or she would have obtained without the help of the good student(s).

2.3.2 Selecting the Set A, B, and C Questions and the Example Tests

Selecting Questions for Set A, Set B, and Set C

Marking the workbook is not as onerous a task as it might at first sound, because the solutions have already been marked, and good students will solve and mark most questions correctly. Also the instructor has complete control of how much marking he or she does in the workbook for each course. Nevertheless the selection of suitable questions for **Set A**, **Set B**, and **Set C** must be done with care. It is desirable to have students solving every possible type of question for each topic covered in a session. However, in practice, this is impossible (unless you have a Teaching Assistant who checks the workbooks for you), because every instructor has many duties outside the classroom. This means that a compromise must be reached. *I carefully select questions for the workbook so that the questions are challenging and the number to be solved and marked is sufficient to get the partnership collaborating,* ***but*** *I have only 3 to 4 hours of marking to do at the end of* ***Session 1*** *and* ***Session 2****, and 2 to 3 hours of marking to do at the end of* ***Session 3****, for each course.* Using this approach, I have found that the amount of marking I must do is not a problem and the goals of *Peer Responsibility* are still achieved.

There are many ways of marking the solutions and the marking in the workbook. I deduct up to 4 marks for each error in each calculation and/or comment within a question or part of a question. I do not try to make each set of questions worth 40 marks per session. I do not even count the total number of marks that can be lost. I base the total number of questions to be solved by each student per session purely on the amount of time it takes me to mark them and keep this under control.

College Algebra questions are usually very short and very quick to mark; so I may select 5 to 15 questions or parts of questions per student for each session. On the other hand, many of the questions in our *Statistics* book take longer to mark than those in our *College Algebra* book, so I may pick perhaps only 3 to 7 questions per student per session. One demanding question in *Section 2.4* of our Statistics book has 5 parts that covers all the work in sections 2.1, 2.2, 2.3, and 2.4. An error in any part could cause a student to lose up to 4 marks and some of the parts involve more than one calculation and/or comment with a potential loss of 4 marks per error. In fact, if all parts of this question were wrong a student could lose 28 marks just for this question alone. In the third session of my Numerical Analysis course, there are only three questions to be completed by each student but each question involves many calculations and/or comments with the possibility of many errors at up to 4 marks per error. There are many other ways of setting and marking questions for the workbook. It took me about two semesters to develop a method of marking the workbook that worked for me. I use this method in every course I teach.

Without bonuses, there are a total of 240 marks for the workbook, 120 for correct solutions and 120 for marking all of one of your partner's solutions correctly. Since there are *three sessions* during a semester, there are 40 marks allocated per session that can be lost due to *solution errors*, and 40 marks that can be lost due to *marking errors* – a total of 80 marks per session. Note that if a student loses a total of more than 40 marks in solution errors in one session, then at the top of the first section of the session, the total marks lost due to solution errors must be recorded as –40 (similarly –40, if the marking errors exceeds 40 marks). The objective is to ensure that each student starts each new session with a total of 40 marks each for *solution errors* and *marking errors*. This strategy, together with the notation and a full explanation, is described in detail in the *Guide*.

Example Tests

I write the Example Tests so that all the topics and concepts in that session are covered. College Algebra may require 25 questions on the Example Test to cover all the topics and concepts. Differential equations may require 14 questions etc. Two of these would be assignments; the remainder would be divided between the partners by the partners. Each partner completes those questions assigned to him or her; they then discuss their solutions with the other partner(s). I make it very clear that all the topics and concepts that could appear on the real test for that session are covered in the Example Test and the workbook problems. To reinforce the importance of the Example Tests, I tell my students that it is essential that they complete the Example Tests because, when I mark the real tests, I can tell who completed them and who did not. **I emphasize that there can be as much as a 20% difference between students who complete the Example Test and those who do not.** The partnerships with good or keen students will divide up, solve and discuss the questions. However, there will always be some students who will not be very keen to do any additional work. However, these students will usually be able to see the folly of not completing the Example Tests! Students use *Peer Responsibility* without using more of the instructor's time (except to answer questions when the partnership gets stuck!). I have found that students quickly learn that they will gain the most by cooperating and working together.

Note that you must never supply written solutions to the questions on the Example Tests. If you do your students will not come to you for help and they will not try to solve the questions themselves, they will just read the solutions, gaining far less than if they attempted to complete them on their own or with their partners. Also when they come to see you, let them tell you what they are doing, and then keep asking questions that push them in the right direction until their problem(s) are solved.

2.3.3 The Instructor's Marks Register and Attendance Register

For easy reference, the marking scheme for **STAPRM** (and **STAPRMJ**) is shown below exactly as it appears in the *Guide*. **STAPRMJ** will be discussed in a separate paper. The mark for the Final is deliberately large so that there is a large unknown at the end of a course. Since students do not know how they will fair in the Final, most students see the wisdom of trying to gain bonuses in their workbooks, assignments, and in-term tests. This has the effect of improving the standard of their work.

1)	**INDIVIDUAL ASSIGNMENTS (6 IN ALL) *OR* JOINT PROJECTS (3 IN ALL)**	**120**
2)	**YOUR SOLUTIONS IN THE WORKBOOK**	**120**
3)	**MARKING ALL THE SOLUTIONS OF ONE OF YOUR PARTNERS**	**120**
4)	**TWO IN-TERM TESTS**	
	Test 1	**120**
	Test 2	**120**
5)	**COMPREHENSIVE FINAL**	**400**
	GRAND TOTAL	**1000**

The Semester is divided into three parts because of *Peer Responsibility* and the *Workbook*. There are two **Excel workbooks** that I believe are essential when using *Peer Responsibility*. This is because one of them keeps track of the marks and grades of each student in a class throughout the course for the instructor. This is discussed in this section. While the other one allows each student to keep track of his or her marks and grades throughout the course. This is discussed in *Section 2.3.4*.

The filename of the first workbook is **MarksRegisterAssignments#**, where the # identifies a course uniquely. This workbook contains five worksheets. Their tabs are labeled *Instructions*, *Marks Register*, *Attendance Register*, *Marking Scheme*, and *Formulae*.

Page 21 is a blank ***Marks Register*** worksheet for **STAPRM**. It is in an ***Excel workbook*** called **MarksRegisterAssignments#**. I use it in all my Mathematics courses except Statistics courses. I enter every mark for each student for each part of the course in this **Excel** worksheet. Page 22 is a ***sample*** *MarksRegisterAssignments* worksheet. Page 23 is the ***sample*** *MarksRegisterAssignments* worksheet with the *Emergency Formulae* row and the seven columns to the right of that part of the worksheet that is normally printed. Page 24 is the sample *Attendance Register* worksheet associated with the sample *Marks Register* worksheet. The *Attendance Register* is a worksheet in the same workbook as the *Marks Register* worksheet, so that, if required, the contents of various cells can be transferred easily between them. **All names and marks in the sample Marks Register and Attendance Register worksheets have been invented.** A complete description of both worksheets, with full instructions about how to use them, is included later in this section.

As the marks are entered into the *Marks Register*, formulae in various columns calculate and display the total mark and grade for each session of the course and the final course mark and grade. The same formulae used in various columns of the *Marks Register* are used in the appropriate columns of an *Excel worksheet* called ***Your Grade*** in a workbook called ***YourGradeAssignments***. This worksheet can be used by students to calculate their own marks and grades during the course. This means that they will always obtain the same mark and grade as the instructor for each session of the course.

All columns, except those for *Assignment* marks and the *Structure Test* column, contain formulae. The **S1 Mk**, **S12 Mk**, and **S123 Mk** columns contain the total percentage at the end of each of their respective sessions and **Crse Mk** contains the percentage for the entire course. The number displayed in all columns with **Mk** in their title has been rounded up.

The columns with **Grd** in them, display the grade associated with the percentage in the column to their immediate left. The total mark and grade is automatically calculated and displayed, as marks are entered into the white columns. Since the *Marks Register* contains the marks and grades of every student in the class, it is not available to students.

One of the following letter grades will be displayed to the right of each test mark or total mark because courses at **Bellarmine University** are graded using the nine letter grades shown below.

F, D, C, C+, B–, B, B+, A–, A

If your school or college uses different letter grades, the formulae that cause the letter grades to be displayed can be changed very easily. Full details about the formulae used in all workbooks discussed in this paper are in a separate document that can be copied via the Internet.

Each letter grade column in the **Marks Register** worksheet is actually two columns, side by side. The letter corresponding to the percentage in the cell to its immediate left will be displayed in the

left cell for letter grades **F** and **D**

and in the

right cell for letter grades **C, C+, B–, B, B+, A–, A**.

Using two columns allows me to put all students with a D or F into one column with the students with higher grades in another column. This makes it easy to identify the at-risk students.

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Term/Year Course Number and Name INSTRUCTOR - Name

MARKS REGISTER FOR COURSES WITH ASSIGNMENTS

SESSION NUMBER			SESSION 1							SESSION 2							SESSION 3					FINAL RESULTS				
#	STUDENT NAME	ST	As1 Mk	As2 Mk	Wb1 Mk	T1 Mk	T1 Grd	S1 Mk	S1 Grd	As3 Mk	As4 Mk	Wb2 Mk	T2 Mk	T2 Grd	S12 Mk	S12 Grd	As5 Mk	As6 Mk	Wb3 Mk	S123 Mk	S123 Grd	Fin Mk	Final Grd	Tot Bon	Crse Mk	Crse Grd
1	LAST NAME *First Name*																							0		
2	LAST NAME *First Name*																							0		
3	LAST NAME *First Name*																							0		
4	LAST NAME *First Name*																							0		
5	LAST NAME *First Name*																							0		
6	LAST NAME *First Name*																							0		
7	LAST NAME *First Name*																							0		
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20	LAST NAME *First Name*																							0		
21	LAST NAME *First Name*																							0		
22	LAST NAME *First Name*																							0		
23	LAST NAME *First Name*																							0		
24	LAST NAME *First Name*																							0		
MEANS																										
NUMBER OF STUDENTS																										

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MARKS REGISTER FOR COURSES WITH ASSIGNMENTS

SESSION NUMBER			SESSION 1							SESSION 2							SESSION 3					FINAL RESULTS				
#	STUDENT NAME	ST	As1 Mk	As2 Mk	Wb1 Mk	T1 Mk	T1 Grd	S1 Mk	S1 Grd	As3 Mk	As4 Mk	Wb2 Mk	T2 Mk	T2 Grd	S12 Mk	S12 Grd	As5 Mk	As6 Mk	Wb3 Mk	S123 Mk	S123 Grd	Fin Mk	Final Grd	Tot Bon	Crse Mk	Crse Grd
1	ABDEN *Alan*	18	15	18	-29	65	D	**69**	**D**	20	20	-16	69	D	**73**	**C**	18	18	-9	**75**	**C+**	52	F	14	**70**	**C**
2	ANSFIELD *Sean*	18	20	20	-1	88	B+	**94**	**A-**	20	20	-1	97	A	**97**	**A**	20	22	3	**98**	**A**	94	A-	16	**100**	**A**
3	BLACK *Andrew*	14	20	18	-13	81	B-	**85**	**B**	18	20	-6	86	B	**88**	**B+**	21	21	6	**90**	**A-**	85	B	12	**92**	**A-**
4	BRYAND *Amanda*	19	19	20	-14	78	C+	**84**	**B**	20	19	-12	83	B	**86**	**B**	19	20	3	**87**	**B**	77	C+	16	**88**	**B+**
5	BURNS *Chris*	17	22	21	-11	88	B+	**92**	**A-**	14	16	-7	95	A	**93**	**A-**	20	20	-4	**94**	**A-**	91	A-	14	**95**	**A**
6	CAMPBELL *Joe*	13	20	20	-12	82	B-	**87**	**B**	20	20	-1	86	B	**90**	**A-**	20	20	-4	**90**	**A-**	80	B-	12	**89**	**B+**
7	CLARK *Connie*	18	13	12	-45	38	F	**45**	**F**	15	20	-26	59	F	**56**	**F**	14	15	-12	**58**	**F**	35	F	16	**54**	**F**
8	DALTON *Elizabeth*	15	20	17	0	89	B+	**94**	**A-**	20	22	-3	93	A-	**96**	**A**	20	21	-4	**96**	**A**	95	A	12	**98**	**A**
9	EGHAM *Mike*	20	20	21	-13	86	B	**90**	**A-**	20	20	-4	86	B	**91**	**A-**	20	21	-2	**92**	**A-**	89	B+	14	**94**	**A-**
10	FORD *Greg*	16	21	23	-3	93	A-	**98**	**A**	18	18	2	95	A	**98**	**A**	19	22	0	**98**	**A**	97	A	14	**101**	**A**
11	GREEN *Heather*	15	19	20	-24	47	F	**61**	**D**	15	18	-16	59	F	**65**	**D**	16	16	-15	**65**	**D**	66	D	16	**72**	**C**
12	HARDING *Alvin*	13	20	20	-47	61	D	**63**	**D**	20	20	-23	57	F	**65**	**D**	15	14	-13	**66**	**D**	71	C	16	**73**	**C**
13	HAYWARD *James*	16	20	20	-25	81	B-	**82**	**B-**	20	20	-23	83	B	**83**	**B**	18	19	-18	**84**	**B**	52	F	10	**73**	**C**
14	HAMILTON *Sarah*	20	18	19	-8	71	C	**81**	**B-**	20	20	-19	87	B	**85**	**B**	20	20	-17	**84**	**B**	86	B	16	**89**	**B+**
15	HERMAN *Joe*	18	20	21	-7	87	B	**92**	**A-**	20	20	-4	93	A-	**94**	**A-**	20	20	-3	**95**	**A**	91	A-	16	**97**	**A**
16	JOHNSON *John*	14	22	20	-15	82	B-	**86**	**B**	19	20	-16	89	B+	**88**	**B+**	20	20	-5	**89**	**B+**	82	B-	14	**89**	**B+**
17	LITTLE *Joan*	16	17	17	6	72	C	**84**	**B**	15	20	2	71	C	**83**	**B**	20	20	-11	**82**	**B-**	77	C+	10	**86**	**B**
18	MACDONALD *Karalie*	18	20	20	-14	75	C+	**82**	**B-**	16	20	-13	71	C	**80**	**B-**	20	20	-9	**81**	**B-**	79	C+	14	**85**	**B**
19	O'DONNELL *Wanda*	16	15	14	-41	46	F	**52**	**F**	9	20	-38	55	F	**55**	**F**	11	13	-31	**56**	**F**	67	D	14	**64**	**D**
20	PHILLIPS *Mike*	18	22	22	-8	94	A-	**97**	**A**	17	20	-7	92	A-	**96**	**A**	23	21	-9	**96**	**A**	73	C	14	**89**	**B+**
21	RANKIN *Nick*	20	20	20	-23	85	B	**86**	**B**	18	20	-7	80	B-	**86**	**B**	20	20	-9	**87**	**B**	82	B-	14	**88**	**B+**
22	SMITH *Betty*	17	20	19	-12	82	B-	**87**	**B**	21	20	-2	91	A-	**91**	**A-**	20	21	-8	**91**	**A-**	90	A-	16	**94**	**A-**
23	TETH *Sean*	20	17	20	-31	47	F	**58**	**F**	13	20	-36	51	F	**58**	**F**	20	17	-10	**61**	**D**	55	F	10	**64**	**D**
24	THOMAS *Inver*	19	18	20	-11	85	B	**89**	**B+**	16	20	-10	90	A-	**90**	**A-**	20	20	-11	**91**	**A-**	86	B	16	**92**	**A-**
	MEANS	**17**	**20**	**20**	**-17**	**76**	**C+**	**81**	**B-**	**18**	**20**	**-12**	**80**	**B-**	**83**	**B**	**19**	**20**	**-8**	**84**	**B**	**78**	**C+**	**14**	**85**	**B**
	NUMBER OF STUDENTS	**24**	**24**	**24**	**24**	**24**		**24**		**24**	**24**	**24**	**24**		**24**		**24**	**24**	**24**	**24**		**24**		**24**	**24**	

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MARKS REGISTER FOR COURSES WITH ASSIGNMENTS

SESSION NUMBER			SESSION 1							SESSION 2							SESSION 3					FINAL RESULTS				
#	STUDENT NAME	ST	As1 Mk	As2 Mk	Wb1 Mk	T1 Mk	T1 Grd	S1 Mk	S1 Grd	As3 Mk	As4 Mk	Wb2 Mk	T2 Mk	T2 Grd	S12 Mk	S12 Grd	As5 Mk	As6 Mk	Wb3 Mk	S123 Mk	S123 Grd	Fin Mk	Final Grd	Tot Bon	Crse Mk	Crse Grd
1	ABDEN *Alan*	18	15	18	-29	65	D	69	D	20	20	-16	69	D	73	C	18	18	-9	75	C+	52	F	14	70	C
2	ANSFIELD *Sean*	18	20	20	-1	88	B+	94	A-	20	20	-1	97	A	97	A	20	22	3	98	A	94	A-	16	100	A
3	BLACK *Andrew*	14	20	18	-13	81	B-	85	B	18	20	-6	86	B	88	B+	21	21	6	90	A-	85	B	12	92	A-
4	BRYAND *Amanda*	19	19	20	-14	78	C+	84	B	20	19	-12	83	B	86	B	19	20	3	87	B	77	C+	16	88	B+
5	BURNS *Chris*	17	22	21	-11	88	B+	92	A-	14	16	-7	95	A	93	A-	20	20	-4	94	A-	91	A-	14	95	A
6	CAMPBELL *Joe*	13	20	20	-12	82	B-	87	B	20	20	-1	86	B	90	A-	20	20	-4	90	A-	80	B-	12	89	B+
7	CLARK *Connie*	18	13	12	-45	38	F	45	F	15	20	-26	59	F	56	F	14	15	-12	58	F	35	F	16	54	F
8	DALTON *Elizabeth*	15	20	17	0	89	B+	94	A-	20	22	-3	93	A-	96	A	20	21	-4	96	A	95	A	12	98	A
9	EGHAM *Mike*	20	20	21	-13	86	B	90	A-	20	20	-4	86	B	91	A-	20	21	-2	92	A-	89	B+	14	94	A-
10	FORD *Greg*	16	21	23	-3	93	A-	98	A	18	18	2	95	A	98	A	19	22	0	98	A	97	A	14	101	A
11	GREEN *Heather*	15	19	20	-24	47	F	61	D	15	18	-16	59	F	65	D	16	16	-15	65	D	66	D	16	72	C
12	HARDING *Alvin*	13	20	20	-47	61	D	63	D	20	20	-23	57	F	65	D	15	14	-13	66	D	71	C	16	73	C
13	HAYWARD *James*	16	20	20	-25	81	B-	82	B-	20	20	-23	83	B	83	B	18	19	-18	84	B	52	F	10	73	C
14	HAMILTON *Sarah*	20	18	19	-8	71	C	81	B-	20	20	-19	87	B	85	B	20	20	-17	84	B	86	B	16	89	B+
15	HERMAN *Joe*	18	20	21	-7	87	B	92	A-	20	20	-4	93	A-	94	A-	20	20	-3	95	A	91	A-	16	97	A
16	JOHNSON *John*	14	22	20	-15	82	B-	86	B	19	20	-16	89	B+	88	B+	20	20	-5	89	B+	82	B-	14	89	B+
17	LITTLE *Joan*	16	17	17	6	72	C	84	B	15	20	2	71	C	83	B	20	20	-11	82	B-	77	C+	10	86	B
18	MACDONALD *Karalie*	18	20	20	-14	75	C+	82	B-	16	20	-13	71	C	80	B-	20	20	-9	81	B-	79	C+	14	85	B
19	O'DONNELL *Wanda*	16	15	14	-41	46	F	52	F	9	20	-38	55	F	55	F	11	13	-31	56	F	67	D	14	64	D
20	PHILLIPS *Mike*	18	22	22	-8	94	A-	97	A	17	20	-7	92	A-	96	A	23	21	-9	96	A	73	C	14	89	B+
21	RANKIN *Nick*	20	20	20	-23	85	B	86	B	18	20	-7	80	B-	86	B	20	20	-9	87	B	82	B-	14	88	B+
22	SMITH *Betty*	17	20	19	-12	82	B-	87	B	21	20	-2	91	A-	91	A-	20	21	-8	91	A-	90	A-	16	94	A-
23	TETH *Sean*	20	17	20	-31	47	F	58	F	13	20	-36	51	F	58	F	20	17	-10	61	D	55	F	10	64	D
24	THOMAS *Inver*	19	18	20	-11	85	B	89	B+	16	20	-10	90	A-	90	A-	20	20	-11	91	A-	86	B	16	92	A-
	MEANS	17	20	20	-17	76	C+	81	B-	18	20	-12	80	B-	83	B	19	20	-8	84	B	78	C+	14	85	B
	NUMBER OF STUDENTS	24	24	24	24	24		24		24	24	24	24		24		24	24	24	24		24		24	24	

EMERGENCY FORMULAE																					0		

LAST NAME	Wb1 S1	Wb2 S2	Wb3 S3	T1 Lost	T2 Lost	Fin Lost
ABDEN	-29	-16	-9	35	31	48
ANSFIELD	-1	-1	3	12	3	6
BLACK	-13	-6	6	19	14	15
BRYAND	-14	-12	3	22	17	23
BURNS	-11	-7	-4	12	5	9
CAMPBELL	-12	-1	-4	18	14	20
CLARK	-45	-26	-12	62	41	65
DALTON	0	-3	-4	11	7	5
EGHAM	-13	-4	-2	14	14	11
FORD	-3	2	0	7	5	3
GREEN	-24	-16	-15	53	41	34
HARDING	-47	-23	-13	39	43	29
HAYWARD	-25	-23	-18	19	17	48
HAMILTON	-8	-19	-17	29	13	14
HERMAN	-7	-4	-3	13	7	9
JOHNSON	-15	-16	-5	18	11	18
LITTLE	6	2	-11	28	29	23
MACDONALD	-14	-13	-9	25	29	21
O'DONNELL	-41	-38	-31	54	45	33
PHILLIPS	-8	-7	-9	6	8	27
RANKIN	-23	-7	-9	15	20	18
SMITH	-12	-2	-8	18	9	10
TETH	-31	-36	-10	53	49	45
THOMAS	-11	-10	-11	15	10	14
MEANS	-17	-12	-8	25	21	23
# OF STUDENTS	24	24	24	24	24	24

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ATTENDANCE REGISTER

	STUDENT NAME		Mar 20	Mar 29	Apr 15	Apr 17	Apr 19	Apr 22	Apr 24	Apr 26								Att Tot	Wb Bon	Tot Bon
1	ABDEN	Alan	1	0	1	1	1	1	1	1								7	0	14
2	ANSFIELD	Sean	1	1	1	1	1	1	1	1								8	0	16
3	BLACK	Andrew	1	0	1	0	1	1	1	1								6	0	12
4	BRYAND	Amanda	1	1	1	1	1	1	1	1								8	0	16
5	BURNS	Chris	1	1	1	0	1	1	1	1								7	0	14
6	CAMPBELL	Joe	1	1	1	1	1	0	1	0								6	0	12
7	CLARK	Connie	1	1	1	1	1	1	1	1								8	0	16
8	DALTON	Elizabeth	1	0	1	1	0	1	1	1								6	0	12
9	EGHAM	Mike	1	1	1	1	1	0	1	1								7	0	14
10	FORD	Greg	1	1	1	1	1	1	0	1								7	0	14
11	GREEN	Heather	1	1	1	1	1	1	1	1								8	0	16
12	HARDING	Alvin	1	1	1	1	1	1	1	1								8	0	16
13	HAYWARD	James	1	1	1	0	0	1	0	1								5	0	10
14	HAMILTON	Sarah	1	1	1	1	1	1	1	1								8	0	16
15	HERMAN	Joe	1	1	1	1	1	1	1	1								8	0	16
16	JOHNSON	John	1	1	1	1	1	0	1	1								7	0	14
17	LITTLE	Joan	0	1	0	1	1	1	0	1								5	0	10
18	MACDONALD	Karalie	1	1	0	1	1	1	1	1								7	0	14
19	O'DONNELL	Wanda	1	1	0	1	1	1	1	1								7	0	14
20	PHILLIPS	Mike	1	1	1	1	1	1	0	1								7	0	14
21	RANKIN	Nick	1	1	1	1	1	1	1	0								7	0	14
22	SMITH	Betty	1	1	1	1	1	1	1	1								8	0	16
23	TETH	Sean	0	1	1	1	1	0	1	0								5	0	10
24	THOMAS	Inver	1	1	1	1	1	1	1	1								8	0	16
TOTAL ATTENDANCE			22	21	21	21	22	20	20	21	0	0	0	0	0	0	0	168	0	336

The Marks Register Worksheet

A blank Marks Register is shown on page 21. Only the area surrounded by black, dark grey, and black rectangles prints, the seven shorter columns to the right of this area do not get printed (although they can be printed if required). A Marks Register with sample data is displayed on Page 22. Page 23 displays this Marks Register together with the additional seven columns and the Emergency Formulae row as they appear on the screen.

A major advantage of using **Excel**, apart from the ease of using formulae, is that students can be sorted into any order, for example, in alphabetical order of last name, descending order of Final examination mark, ascending order of Session 1 grade, etc.

All columns except those headed **AS** and **ST** contain formulae. The **Wb** columns contain the marks for the workbook. The **T** followed by **1** or **2** columns contain test marks. **S1 Mk**, **S12 Mk**, and **S123 Mk** columns contain the total percentage at the end of each of their respective sessions and **Crse Mk** contains the percentage for the entire course. All the columns with **Grd** in their title contain a letter grade corresponding to the mark in the column to its immediate left.

As marks are entered into the **ST**, **AS** columns, and the six shorter white columns to the right of the main spreadsheet, formulae enter them into the **Wb?**, **T?**, and **S?** columns. A complete discussion of the formulae is not included in this version of the paper.

Note that if all formulae in one column are overwritten or deleted they can be copied back into a cell or an entire column using the formula in the Emergency Formulae line below the column. This line is displayed below the red-bordered area when the Marks Register worksheet is on the screen.

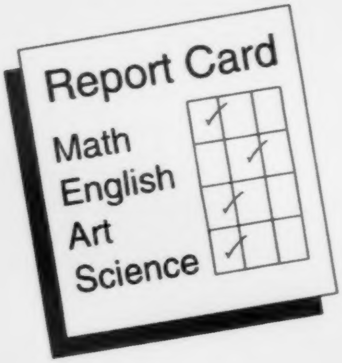
The next six pages explain how to use the workbook **MarksRegisterAssignments#.xls**. They are a copy of the instructions on the **Instruction tab** in this workbook. They are divided into the four main sections listed below :

Instructions for Using the Marks Register and the Attendance Register Worksheets

How to Use the Marks Register

How to Use the Attendance Register

The Marking Scheme for the Entire Course



INSTRUCTIONS
FOR USING THE
MARKS REGISTER AND THE ATTENDANCE REGISTER WORKSHEETS

(For Courses with Assignments)

1) There are five named tabs at the bottom of this spreadsheet :

Instructions	-	this worksheet.
Marks Register	-	this worksheet calculates and displays the grade for each test and the mark and grade at the end of each session for each student, after the assignments marks, the total number of marks lost due to errors and/or gained due to bonuses in the workbook, and the test marks have been entered. It also calculates and displays the final course mark and grade for each student.
Attendance Register	-	this worksheet allows the instructor to record attendance bonuses, if any, and any other bonus marks awarded during the semester. The total per student is automatically transferred to the **Tot Bon** column *(Total Bonuses* column) of the *Marks Register*.
Marking Scheme	-	this worksheet gives the marks allocated for each session.
Formulae	-	this worksheet display the formulae used in the **Marks Register** and the **Attendance Register**. A detailed analysis of the formulae is in a separate **Word** document.

2) To display the **Marks Register**, the **Attendance Register**, the **Marking Scheme**, or the **Formulae** worksheet, click on the appropriate tab below. The **Formulae** worksheet displays the formulae in the **Marks Register**. You can return to these instructions any time you want to by clicking on the tab marked **Instructions**. *The colors in all five worksheets have been selected so that they will print clearly in grayscale.*

3) All the formulae in the **Attendance Register**, except those in the **Tot Bon** (*Total Bonuses*) column, are row or column sums. The number in each **Tot Bon** cell is the total number of attendances per student multiplied by 2, since each eligible attendance counts as two bonus marks, plus any joint and/or individual workbook bonuses that have be earned. For example, the formula in the **Tot Bon** column for the first student is **X9*2+Y9**. Note that bonuses for the workbook, if any, are awarded at the end of a course.

4) **ALL** columns with **Mk** in their column name and all numbers in the **MEANS** row are rounded *UP*.

HOW TO USE THE MARKS REGISTER

1) First Row of Spreadsheet

SEMESTER/YEAR - Example : F2002
COURSE NUMBER AND NAME - Example : M205 - Elementary Statistics
INSTRUCTOR : Name - Example : Instructor : Mike Bankhead

When the above three items are entered into the first row of the Marks Register, they are automatically copied to first row of the Attendance Register.

2) First Three Columns : # STUDENT NAME ST

- This column displays a number for each student from 1 to the class size. **When the number of a student is entered into the Marks Register, it is automatically copied to the appropriate cell in the Attendance Register.**

The column with **#** as its name can be numbered from **1** up to the class size, cell by cell. It is also possible to use a very simple formula to generate the integers from **2** to the class size. Enter **1** into cell **D11** , the formula **=D11+1** into cell **D12**, and then copy this formula to the bottom of this column. *If rows are added or deleted, this column will have to be re-numbered.*

STUDENT NAME - This is two columns. The first column displays the student's last name. The second column displays the student's first name. **When the name of a student is entered into the Marks Register, it is automatically copied to the appropriate cells in the Attendance Register.**

ST - This column records the **Structure Test** mark for each student.

3) Columns under the Session 1, Session 2, and Session 3 Headings

A1 - Assignment 1 mark

A2 - Assignment 2 mark

Wb Mk - Total marks lost plus bonuses gained in the workbook for the Session 1. The instructor can enter this total directly into this column or let formulae transfer them from the **Wb S1** column to the right of the red-bordered area.

T1 Mk - Test 1 Mark. The instructor can enter a students Test 1 mark directly into this column or, if preferred, a formula can be used for easy curving using the **T1 Lost** column to the right of the red-bordered area.

T1 Grd - The grade that corresponds to the Test 1 mark. This column is two columns side by side. The first column lists grades **D** or **F** only. This allows for easy identification of the "***at risk***" students. The second column lists grades **C**, **C+**, **B-**, **B**, **B+**, **A-**, or **A**.

S1 Mk - The Session 1 mark after combining the Assignment 1 and 2, Workbook, and Test 1 marks.

S1 Grd - The grade that corresponds to the Session 1 mark.

Marks can be entered directly into the columns above with **blue** names. However, formulae are available that will permit the marks for **Test 1** to be curved, if required. This is explained in *Section 6* later in this section. The total marks lost for the workbook in each session can be entered directly into the green columns in each session. However, they can also be entered into the three white columns to the right of the area enclosed in red. In which case, formulae transfer them into the appropriate columns in each session. This option is available so that each student's workbook marks can be more easily compared.

Columns with red names are formulae that do not need to be changed. The format of the formulae of **all** cells with **Grd** in their heading is the same. Each cell in this column displays the grade corresponding to the mark in the cell to its immediate left. The column headings in Session 2 and Session 3 are the same except the number in each column heading changes to a **2** or a **3** *i.e. AS1 becomes AS2 in Session 2 etc.* There is ***no*** Test 3 in Session 3.

4) FINAL RESULTS Section

Final - Final Mark. The instructor can enter each student's Final mark directly into this column or, if preferred, a formula can be used for easy curving using the **Fin Lost** column to the right of the red-bordered area.

Final Grd - The grade that corresponds to the Final mark. This column is two columns side by side. The first column lists grades **D** or **F** only. This allows easy identification of the "***at risk***" students. The second column lists grades **C**, **C+**, **B–**, **B**, **B+**, **A–**, or **A**.

Tot Bon - This number is automatically transferred from the **Tot Bon** column in the **Attendance Register** using a formula - See **Formulae worksheet**.

Crse Mk - The total mark for the entire course after combining all the *Assignment marks*, *Workbook marks*, the *two In-term Test marks*, the *Final*, and any *bonuses* in the **Tot Bon column**.

Crse Grd - The grade that corresponds to the number in the **Crse Mk** column. This grade, in the brown column, is the final grade for each student for the entire course.

As before, those columns above with **red** names contain formulae that never need changing. All formulae are displayed in the **Formulae worksheet**.

5) MEANS Row

The means in the means row are calculated by summing the marks in the column above them and dividing by the integer in the white cell below them. Each mean is rounded up. The instructor can enter the number of students who took a test, or who completed their workbook, etc., into this cell. The reason for the *Number of Students* row is to allow for absent students.

6) The Six White Columns with Blue Column Headings

All six **Assignments** are marked out of **20** marks. **Test 1**, **Test 2**, and the **Final** are marked out of **100 marks**. The workbook marks in each of the three sessions is $S_T + M_T$. This mark could be negative, if the student has lost marks in their workbook overall, or positive, if the number of marks gained as bonuses, exceeds the number of marks he or she has lost due to solving and marking errors. Formulae in the worksheet scale these marks in accordance with the marking scheme so that the correct mark and grade are displayed at the end of each session, and at the end of the entire course. If all six *assignment marks*, the *Test 1 mark*, the *Test 2 mark*, the *Final mark*, and all three *workbook marks* are entered directly into the columns under the Session 1, Session 2 headings, etc., the six columns with column labels **AR** to **AZ** can be ignored.

There are seven columns to the right of the red-bordered area. The column address of each of these columns is shown in red below. This is followed by the cell content of each of two rows. These are shown in blue below. They are on a blue background in the *Marks Register*.

Column Address	**AT**	**AU**	**AV**	**AW**	**AX**	**AY**	**AZ**
Cell Content	**LAST NAME**	**Wb**	**Wb**	**Wb**	**T1**	**T2**	**Fin**
Cell Content		**S1**	**S2**	**S3**	**Lost**	**Lost**	**Lost**

There are two columns under **STUDENT NAME**. The first is for each last name and the second for each first name. When the last name of a student is entered into the left column under **STUDENT NAME**, it will automatically be copied to column headed **LAST NAME** on the right of the spreadsheet. The only reason for this is to have the last name of each student near the marks in columns **AU** to **AZ**.

a) The Columns AU, AV, and AW (i.e. the Wb S1, Wb S2, and Wb S3 columns)

In order to make it easier to compare a student's workbook performance in each of the three sessions, the marks for the workbook can be entered into the three adjacent columns **AU**, **AV**, and **AW**. The formulae discussed below automatically transfer each workbook mark from these columns to the correct column in the appropriate session.

IF YOU ENTER THE MARKS DIRECTLY INTO THE WORKBOOK COLUMNS OF EACH SESSION, OR INTO THE AU, AV, AND AW COLUMNS, YOU DO NOT NEED TO READ OR UNDERSTAND THE REMAINDER OF THIS SECTION, THE FORMULAE WILL DO ALL THE WORK FOR YOU.

The formula **=AU#** is in column **J** in **Session 1**. The # is the row number, which is different for each student. This formula transfers the workbook marks from the **AU** column with heading **Wb S1** to column **J** in **Session 1**.

The formula **=AV#** is in column **S** in **Session 2**. As above, the # is the row number for each student. This formula transfers the workbook marks from the **AV** column with heading **Wb S2** to column **S** in **Session 2**.

The formula **=AW#** is in column **AB** in **Session 3**. As above, the # is the row number for each student. This formula transfers the workbook marks from the **AW** column with heading **Wb S3** to column **AB** in **Session 3**.

b) The Columns AX, AY, and AZ (i.e. the T1 Lost, T2 Lost, and Fin Lost columns)

IF YOU ENTER THE TEST MARKS DIRECTLY INTO THE COLUMNS HEADED T1 Mk, T2 Mk, AND Fin Mk, YOU DO NOT NEED TO READ OR UNDERSTAND THE REMAINDER OF THIS SECTION. ENTERING THE MARKS DIRECTLY INTO THESE COLUMNS WILL ERASE THE FORMULAE IN THEM.

i) The formula below is in cell **K11**. This is the cell immediately under the column heading **T1 Mk**.

=IF(AX11=" "," ",ROUNDUP((100-AX11)/100*100,0))

If the content of **AX11** is a space, then this formula will put a space into cell **K11**. This is purely to make the worksheet look neater. If the content of **AX11** is a positive number, this formula will subtract the number in **AX11** from 100 and enter the result into **K11**. For example, if the content of **AX11** is **10**, meaning that the student has lost **10** marks out of **100**, the content of the cell **K11** will be 90%, although the percentage symbol will not be displayed.

The formulae in the rest of column **T1 Mk**, and in columns **T2 Mk**, and **Fin Mk** look very similar to the above formula. The only difference, from column to column, and row to row, is the column letter, shown in **gold**, and the row number, shown in **blue**. For all cells under the **T1 Mk** heading the column letter in the formula is **AX**. The row number in the formula starts at **11** for student number **1**, and increases in steps of **1** up **34**, for student number **24**.

If the total number of marks in each test is **100**, then if the number of marks **lost** by each student in each test is entered into the columns **AX**, **AY**, and **AZ**, as positive numbers, then the formulae in the **T1 Mk**, **T2 Mk**, and **Fin Mk** columns will record the marks as a percentage.

The formula is written in the form shown above so that the **red 100's** can be changed to allow for the possibility of a test being out of more or less than 100 marks, and also so a set of marks can be easily "*curved*". Both situations are discussed below.

ii) If the total number of marks in **Test 1** is NOT 100, put the cursor into the first cell under the column heading **T1 Mk**, its cell address is **K11**, and the following formula will be displayed :

=IF(AX11=" "," ",ROUNDUP((100-AX11)/100*100,0))

replace the two **red 100's** in the above formula with the total number of marks for the **Test 1**, and the mark will be converted into a percentage. For example, if the maximum score on **Test 1** is **142** the above formula becomes

=IF(AX11=" "," ",ROUNDUP((142-AX11)/142*100,0))

Then use **Ctrl C** and **Ctrl V** to copy this amended formula down the column, and all the marks in this column will be percentages. If necessary, do the same for **Test 2** and the **Final**.

iii) **Excel** can sort the entire class list into ascending or descending order of marks or grades, within any column in the spreadsheet, i.e. the class can be sorted into descending order of their Final test score, descending order of their final course mark or course grade, and, of course, alphabetical order of last name, etc. *Note that if you have used any or all of the* ***AX*** *to* ***AZ*** *columns, all of these columns that contain numbers* ***MUST*** *be highlighted before starting the sort.*

c) The Tot Bon Column (Total Bonus Column)

The Total Bonus consists of any *Attendance Bonus*, 2 marks per attendance, plus the *Workbook Bonus*, if any, added together. This total is in the **Tot Bon** column of the **Attendance Register**. The formula below

='Attendance Register'!Z9

automatically copies the Total Bonus for each student from the **Tot Bon** column in the **Attendance Register** to the **Tot Bon** column in the **Marks Register** i.e. the **red values** in the **Attendance Register** become the **red values** in the **Marks Register**.

d) The Mean and the Number of Students Rows

Each cell in the **MEANS** row contains the sum of the numbers in the column above it, divided by the number in the **Number of Students** row. The number is rounded **UP**. It is the mean of the number of students who actually completed the assignment, took the test, etc. The **Number of Students** row lets the instructor enter the number of students who took each method of assessment. It allows for the fact that some students may be absent on the day of a test, or fail to hand in an assignment, etc.

HOW TO USE THE ATTENDANCE REGISTER

1) As you enter the Term and Year, the Course # and Name, and the instructor's name into the first row of the **Marks Register**, it will be automatically copied to the first row of the **Attendance Register**. As you enter the number, first name, and last name of each student they too, will be automatically copied to the **Attendance Register**.
2) The cells above each column to the right of **Student Name** are for the date. In each cell below the date enter a **1** if a student is present, and a **0** if a student is absent. I make a copy of the **Attendance Register** and pass it around the class. I tell each student to enter a **1** alongside his or her name. Before I pass it around the class again, I enter **0's** alongside the names of all absent students.
3) The total number of attendances will be displayed in the **Att Tot** (*Attendance Total*) column.
4) Any additional bonus for the presentation of the entire workbook can be entered into **Wb Bon**.
5) The formula in the **Tot Bon** (*Total Bonuses*) column is **=X9*2+Y9**. It multiplies the content of the **Att Tot** column by 2, and adds the content of the **Wb Bon** column to it, for each student. The formula **='Attendance Register'!Z9** transfers this total from the **Attendance Register** to the **Tot Bon** column in the **Marks Register** for each student.

THE MARKING SCHEME FOR THE ENTIRE COURSE

1) When you select the **Marking Scheme** tab the marking scheme for the entire course will be displayed.
2) Each assessment method has a color associated with it. **Assignments** have a yellow background; items associated with the **workbook** have a green background; and items associated with **tests** have a blue background.
3) The **Assignments** are marked out of **20**; all **tests**, including the **Final**, are marked out of **100**; and the total marks that can be lost ***per session***, due to solution and marking errors in the workbook combined, is **80**. These marks are shown in the **Marks** column in the **Marking Scheme** worksheet.
4) The marks shown in the **Scaled Marks** column show the number of marks that each assessment item is worth out of the 1000 marks available for the entire course.
5) In the marking scheme for the entire course, **assignments** are worth **12%**, the **workbook** is worth **24%**, **Test 1** and **Test 2** together, are worth **24%**, and the **Final** is worth **40%** of the total mark for the course. This means that **66%** of the total marks for the course are for tests. The formulae that calculate the total mark for each session and for the entire course, weight each assessment item according to these percentages.

The Attendance Register Worksheet

Every *Marks Register* workbook includes an *Attendance Register* worksheet. *Page 24* is the sample ***Attendance Register*** in the **MarksRegisterAssignmentsSampleData** workbook.

I set up the *Marks Register workbook*, so that I only need one *Marks Register* for all students in one class. My class size is never more than 35 so I can read the printed output without difficulty. If you have more than 35 students in a class, it would probably be wise to create two *Marks Registers*, otherwise the characters on the printed output could be too small to read.

When I enter the names of my students into the *Marks Register*, they are automatically transferred to the *Attendance Register*. The **Tot Bon** column in the *Marks Register* contains a formula that automatically transfers the total attendance marks and any other bonuses in the *Attendance Register* to the *Marks Register*. Sometimes the workbook of a partnership is so good and so much better than the workbooks of other partnerships that I want to give them some additional bonuses. I put them into a column of the *Attendance Register* so that the formulae automatically transfer them to my *Marks Register*.

The Marking Scheme Worksheet

Page 33 is a copy of the *Marking Scheme* for the entire course when assignments are used in the course (**STAPRM**). It is a worksheet in the **Marks Register**. It is also a worksheet in the **YourGradeAssignments** workbook.

MARKING SCHEME
FOR COURSES WITH
ASSIGNMENTS

SESSION 1

SOURCE OF MARKS	MARKS	SCALED MARKS
ASSIGN 1 AND 2	40	40
SOLUTION ERRORS	40	40
MARKING ERRORS	40	40
TEST 1	100	120
TOTAL FOR SESSION 1		**240**

SESSION 2

SOURCE OF MARKS	MARKS	SCALED MARKS
ASSIGN 3 AND 4	40	40
SOLUTION ERRORS	40	40
MARKING ERRORS	40	40
TEST 2	100	120
TOTAL FOR SESSION 2		**240**

SESSION 3

SOURCE OF MARKS	MARKS	SCALED MARKS
ASSIGN 3 AND 4	40	40
SOLUTION ERRORS	40	40
MARKING ERRORS	40	40
TOTAL FOR SESSION 2		**120**

FINAL RESULTS

SOURCE OF MARKS	MARKS	SCALED MARKS
FINAL	100	400
TOTAL FOR LAST PART		**400**

TOTAL FOR COURSE (WITHOUT STRUCTURE TEST)	**1000**
TOTAL FOR COURSE (WITH STRUCTURE TEST)	**1020**

2.3.4 YourGradeAssignments - The Student's Mark and Grade Form

When **STAPRM** is used (students complete **Assignments**), students should use the **Excel** workbook with filename **YourGradeAssignments.xls** to keep track of their mark and grade throughout the course. There are three tabs in this workbook. Their names are **Instructions**, **Your Grade**, and **Marking Scheme**. When this workbook is opened the **Instructions** worksheet is displayed. This worksheet explains how to use the **Your Grade** worksheet. It is shown on *Page 35*. The **Your Grade** worksheet, on *Page 36*, allows each student to calculate their own mark and grade at the end of each of the three sessions and to **forecast** the mark they need in the Final to obtain any particular grade for the entire course. The formulae in this worksheet are identical to those in the instructor's **MarksRegisterAssignments#.xls** workbook. The **Marking Scheme** worksheet, on *Page 33*, is a copy of the marking scheme for a course that uses **STAPRM**.

I introduce the **Your Grade** worksheet around the fourth to sixth week of term. It is included on every *Semester Plan*. My students have been using the **Your Grade** worksheet for over four years and almost every student uses it. However, it is obvious that although the workbook opens on the instructions, they rarely read them. This has led to my second catchphrase "*If all else fails, read the instructions*"!

I would recommend making this file available to your students because it gives them feedback about their progress throughout the course. I have had a number of students ask me if the formulae were correct in these files and, after I have confirmed that they were correct, the student has said something like "*I did not know I was doing so badly, I had better do some work*". Under these circumstances they usually ask if they can do something for extra credit. I tell them that while I do not offer additional work for extra credit, by improving their solutions and the standard of their work in their workbook they can obtain unlimited bonuses. At times the positive effect that this has had has been quite startling! Another advantage that these worksheets have for the instructor is that it saves time, because there is no need for any student to ask about their progress on the course – they can work it out for themselves!

INSTRUCTIONS
FOR USING
THE *CALCULATING AND FORECASTING YOUR GRADE* WORKSHEET

(For Courses with Assignments)

1) There are three named tabs at the bottom of this spreadsheet :

Instructions	–	this worksheet.
Your Grade	–	the worksheet which will calculate and display your mark and grade at the end of each session, after you have entered your name (optional), your assignment marks, the number of marks in your workbook that have been lost due to solution and marking errors together with the marks gained due to bonuses, and your test marks.
MarkingScheme	–	this worksheet gives the marks allocated for each session.

2) **All three worksheets in this Excel workbook are protected so you cannot accidentally delete a formula or title in a cell.**

3) To display the ***Your Grade*** worksheet click on the tab marked ***Your Grade***. You can return to these instructions any time you want to by clicking on the tab marked ***Instructions***. The colors in the ***Your Grade*** worksheet have been selected so that the worksheet will print clearly in greyscale.

4) Copy this file onto a floppy disk, zip disk, or hard drive. Now open this file in **Excel**.

5) The formulae in the ***YourGrade*** worksheet expect each white cell to contain a number. If you see ##### or # ## in one or more of the colored cells, there is a non-numeric entry into one or more of the white cells. You will need to locate the non-numeric entry and change it to a numeric entry (note that there may be more than one non-numeric entry). Once the white cells contain numeric entries, your mark and grade will be displayed correctly.

6) Each the small colored box contains a formula which includes a conditional statement that will leave this type of box blank when **ONE** space is entered into the small white box to the right of a green or blue box. For example, one space entered into the white box to the right of ***Test 1 Mark***, will leave the box to the right of **Test 1 Grade** blank. This strategy prevents marks or grades being displayed in later sessions that would be meaningless. It is for convenience only.

7) You must enter your marks into the white cells. To make data entry easier, press the **TAB** key to move down the worksheet from white cell to white cell and **SHIFT TAB** to move up the worksheet from white cell to white cell.

8) Press **TAB** until the cursor is in the cell to the right of NAME and enter your name into the cell provided, (this is optional), press **TAB** again and enter the score you obtained for your *Structure Test*, an integer from 1 to 20, into the space provided.

9) Enter your Assignment *1*, Assignment *2* marks, marks lost due to *Solution Errors* (**S_T**), marks lost due to *Marking Errors* (**M_T**), and Test *1* marks into the appropriate boxes in the **Session 1** area of the **YourGrade** worksheet. After you enter your marks into the appropriate boxes in **Session 1**, your **Session 1** course mark and grade will be displayed. Repeat this process for the equivalent cells in **Session 2** etc..

DO NOT ADD YOUR SESSION 1 TOTAL TO YOUR SESSION 2 TOTAL ETC.

10) You can enter any integer into the white box to the right of ***Estimated Final Mark,*** to forecast the smallest mark you would need in the Final, to complete the course, with the grade you would like to have as a final course grade.

CALCULATING AND FORECASTING YOUR GRADE

by

Mike Bankhead

(For Courses With Assignments)

NAME	

Structure Test Mark (*This is a Bonus Mark*)	

COURSE GRADE AFTER COMPLETING SESSION 1

Assignment 1		**S1 Wb Solution Errors (S_T)**	
Assignment 2		**S1 Wb Marking Errors (M_T)**	

Test 1 Mark		**Session 1 Mark**	
Test 1 Grade		**Session 1 Grade**	

COURSE GRADE AFTER COMPLETING SESSIONS 1 AND 2

Assignment 3		**S2 Wb Solution Errors (S_T)**	
Assignment 4		**S2 Wb Marking Errors (M_T)**	

Test 2 Mark		**Session 1 and 2 Mark**	
Test 2 Grade		**Session 1 and 2 Grade**	

COURSE GRADE AFTER COMPLETING SESSIONS 1, 2, AND 3

Assignment 5		**S3 Wb Solution Errors (S_T)**	
Assignment 6		**S3 Wb Marking Errors (M_T)**	

Session 1, 2, and 3 Mark		**Session 1, 2 and 3 Grade**	

FORECASTING YOUR COURSE GRADE FROM YOUR FINAL MARK

Total Bonuses		**Estimated Course Mark**	
Estimated Final Mark		**Estimated Course Grade**	

3. THE SPECIAL TECHNIQUES

A summary of all 23 techniques is given first, followed by four sub-sections. Each sub-section describes those techniques designed to accomplish the objective specified in the sub-section heading. The numbers at the end of each technique indicates the rank of the technique. These numbers were obtained from my evaluation form completed by all students at the end of a course.

SUMMARY OF THE SPECIAL TECHNIQUES

3.1 TECHNIQUES TO REDUCE MATHS ANXIETY

1) Provide Complete Solutions to Some Typical Problems Written Using the Language of Mathematics Correctly - ***15th***
2) Provide an Example Test Before Each Real Test (Including the Final) - ***1st***
3) No Time Limit on Tests, Including the Final (as far as possible) - ***3rd***
4) Take One Sheet of Paper into a Test Including the Final - ***2nd***
5) All Questions on the Tests Straight from or Similar to Questions in the Textbook on or the Example Tests - ***Joint 4th***
6) ***Never*** Require Students to Remember Formulae ***BUT*** Must Know ***When*** to Use a Formula and, If the Formula has been Forgotten, Must Know Where to Find It - ***7th***
7) Graded Bonuses on all Tests (to encourage them to think during the Test) - ***Joint 4th***
8) Providing Information in Exchange for Marks During any Test (still to be tested).

Peer Responsibility has also had a substantial positive impact on the attitude of my students in all of my courses. It is discussed in *Chapter 5* of this paper.

3.2 TECHNIQUES TO GIVE STUDENTS HOPE THROUGHOUT THE COURSE

9) Unlimited Bonuses Available for the Solutions in the Workbook - ***6th***
10) 90% or More in Final Rule for *Eligible Students* *(Provided* ***ALL*** *Assignments/Projects and Workbook Complete)* - ***8th***
11) Top 25% in Final Rule for *Eligible Students* *(Provided* ***ALL*** *Assignments/Projects and Workbook Complete)* - ***9th***

3.3 TECHNIQUES TO IMPROVE STANDARDS

12) ***Peer Responsibility*** - Completing Sets of Questions from the textbook ***(10th)*** and Marking The Questions of ***ONE*** Partner in the Workbook ***(20th)***. This is discussed in *Chapter 5* of this paper.
13) Any Numerical Answer Requires a Sentence Containing the Number in the Context of the Question - ***Absolutely Last As Always!***
14) Showing Students Errors Made by Students in Previous Courses - ***14th***
15) Bonus Marks for Attendance During the Last Four Weeks of the Course (to be tested).

3.4 TECHNIQUES THAT HAVE CHANGED MY STYLE OF TEACHING

16) Use Textbook as a Set of Notes to Minimize the Amount of Writing Students Do In Class - ***Joint 11th***
17) Make and Use Transparencies of Graphs, Tables, Rules, etc. So Time is Not Wasted Drawing or Writing Them on the Blackboard - ***12th***
18) Use Colored Chalk or Colored Markers on the Board - ***16th***
19) Create ***Alternative Methods*** For Those Topics that Cause Difficulty - ***13th***
20) Additional Voluntary Tutorials – ***17th***
21) Marking Scheme for All Tests (Available to Students) with *Partial Credit* throughout All Questions - ***Joint 11th***
22) Constantly Asking Questions During Class - ***18th***
23) Using a *Metalanguage* with the TI-83 Calculator - ***5th***

3.1 TECHNIQUES TO REDUCE MATHS ANXIETY

1) PROVIDE COMPLETE SOLUTIONS TO SOME TYPICAL PROBLEMS USING THE LANGUAGE OF MATHEMATICS CORRECTLY

Mathematics is a language. However, it is certainly not intuitive! I want my students to write their solutions using the language of mathematics correctly, but when I write a solution on the blackboard, I partly say and partly write it. Clearly, I cannot expect my students to write solutions correctly, if they do not see solutions written correctly. So during the first few weeks of the semester, I write solutions to some of the questions from the textbook so that my students know how to complete solutions in their workbooks. I do this for all of the courses I teach. An example solution for College Algebra is shown below. An example solution for Statistics, including the TI-83 key sequences, starts on the next page. Over the last few years, I have developed a collection of solutions for each course I teach. I keep them in my computer area so my students can print them whenever they are needed. This means I do not have to write more solutions each term.

In all courses except my Statistics courses, I assign *six* questions during the semester from the *Example Tests*, *two* from *Example Test 1*, *two* from the *Example Test 2*, and two from the *Example Final*. Students in my Statistics courses complete *Joint Projects* instead of assignments – the acronym for this teaching methodology is **STAPRMJ**. It will be discussed in a future paper. On the day I collect the assignments for marking I either distribute detailed solutions to the assignments or put them into my computer area. For speed, I usually hand write the solutions on blank copier paper that I have printed widely spaced lines onto using a laser printer. The filename for this **Word** file is **LinedBlankPaper.doc**. It is available via the Internet. I do this because our copier can copy and staple sets of solutions from this original. However, it frequently miss-feeds the college-lined paper from our bookstore. Students also complete tests on this paper.

In general, I select the more demanding questions from the *Example Tests* as assignments, usually those that cover the more difficult concepts in the course. I refer to these problems as *Directed Questions*. This means that there will be questions on the real *Test 1*, *Test 2*, and the *Final* that cover similar concepts. Therefore, assuming the concepts involved have been fully understood, there will be two questions on each test that each student should be able to complete, even though they cover the more difficult concepts in the course. This also helps reduce the worries my students have before a test.

COLLEGE ALGEBRA EXAMPLE FOR TECHNIQUE 1

In the following problem, perform the indicated operations and simplify.

$$8x - 4\{-[8x - 4(3 + 2x)] - 6(3x - 2) - 4\}$$

Solution

$$\begin{aligned}
8x - 4\{-[8x - 4(3 + 2x)] - 6(3x - 2) - 4\} &= 8x - 4\{-[8x - 12 - 8x] - 6(3x - 2) - 4\} \\
&= 8x - 4\{-[-12] - 6(3x - 2) - 4\} \\
&= 8x - 4\{12 - 18x + 12 - 4\} \\
&= 8x - 4\{20 - 18x\} \\
&= 8x - 80 + 72x \\
&= 80x - 80
\end{aligned}$$

Note : I use the colors shown above on a whiteboard so that students can easily see the different levels of brackets. I remove the brackets in alphabetical color order i.e. black, blue, green, red (so I remember which colors to use for which brackets!!!). I make a negative sign outside a bracket red on the blackboard or whiteboard until the brackets are removed.

STATISTICS EXAMPLE FOR TECHNIQUE 1

The **Chapin Social Insight Test** evaluates how accurately the subject appraises other people. In the ***reference population*** used to develop the test, scores are approximately normal with *mean* **25** and *standard deviation* **5**. The range of possible scores is **0** to **41**.

a) What **proportion** of the population has scores above **20** on the **Chapin Test** (**Sentence**)? Why would you expect this proportion to be almost the same if you used **41** as the upper limit instead of **+∞**?

b) How high a score must you have in order to be in the top **25%** of the population in *social insight* (**Sentence**)? What are Q_2 and Q_3 for this distribution?

Solution

a) The objective is to find the area to the right of **x = 20**. This area can be obtained using the **normalcdf(** function on the **TI-83**.

normalcdf(20, 1E99, 25, 5) = 0.8413447404

This is **0.8413 to 4D**. So the area, and hence the proportion, to the right of **x = 20** is **0.8413**.

The final sentence is :

> The proportion of the population who obtain a score greater
> than **20** on the **Chapin Social Insight Test** is **0.8413**.

The proportion would be almost the same, because **41** is **3.2** standard deviations from the mean of this distribution and the **68 – 95 – 99.7** rule states that **99.7%** of the observations will be within **3 standard deviations** of the mean. Thus there is very little area to the right of **41**. Note that **3.2** is the **z-score** of **41** (i.e. **3.2 = (41 – 25)/5**).

Note

normalcdf(20, 1E99, 25, 5) = 0.8413 to 4D **normalcdf(**20, 41, 25, 5) = 0.8407 to 4D

The ***key sequence*** for the function **normalcdf(20, 1E99, 25, 5)** on the **TI-83** is :

KEY SEQUENCE	DISPLAY
< 2nd > < VARS > 2	normalcdf(
< 2 > < 0 > < , >	normalcdf(20,
1 < 2nd > < , > 9 9 < , >	normalcdf(20,1E99, *Note : (1E99 = +∞)*
2 5 < , >	normalcdf(20,1E99,25,
5 <) >	normalcdf(20,1E99,25,5)
< ENTER > (or })	0.8413447404

b) The objective is to find a value of **x** such that the area to the right of **X = x** is **0.25**. This value can be obtained using the **invNorm(** function on the **TI-83,** noting that the area to left of the required **x** is **0.75**.

invNorm(0.75, 25, 5) = 28.37244875

This is **28.37 to 2D**. The area to the left of **x = 28.37** is **0.75,** so the area to its right is **0.25**. Thus if your score is approximately **28.37** or more, you will be in the top **25%**.

The final sentence is :

> A person must have a score of **28.37** or higher on the **Chapin Social Insight Test** in order to be in the top 25% of the population in **social insight**.

Finally, $Q_2 = 25$ because the mean is equal to the median for a symmetric distribution, and $Q_3 = 28.37$ because the area to the right of **28.37** is **0.25** and the area to the left of **28.37** is **0.75**.

The ***key sequence*** for the function **invNorm(0.75, 25, 5)** on the **TI-83** is :

KEY SEQUENCE	DISPLAY
< 2nd > < VARS > 3	invNorm(
0 < · > 7 5 < , >	invNorm(0.75,
2 5 < , >	invNorm(0.75, 25,
5 <) >	invNorm(0.75, 25, 5)
< ENTER > (or ↵)	28.37244875

NOTE : You do not need to include the *key sequence* in your solution.

REMINDER

The symbols **<** **>** are called *angle brackets*. In the tables above, they are used on either side of the name of a key on the calculator keyboard. When you see these symbols, find the key with the name on it, and press it. For example, when you see the symbols **< 2nd >**, find and press the *yellow key* marked **2nd** on the calculator (it is the only yellow key on the calculator). The symbol **< → >** is used to represent the *right arrow key*. The integers 0, 1, 2, , 9 are *NOT* enclosed in *angle brackets* in the above tables. Characters that are output to the screen by the calculator, are shown as *underlined characters* in the **DISPLAY** column of the tables.

2) PROVIDE AN EXAMPLE TEST BEFORE EACH TEST (INCLUDING THE FINAL)

The objective of providing *Example Tests* is to show my students the format of the real tests, thus reducing the anxiety associated with taking a real test. Between two and three weeks before each test, I put an *Example Test* into my computer area and instruct my students to obtain a copy of it. None of the questions on any *Example Test* appear on any real test. When I first started to use this technique, I just put a copy of a test I had used the previous term into my computer area. Now with many years of experience, each *Example Test* consists of two parts. **Part A** is a complete test taken by my students on the course in a previous semester. **Part B** consists of additional questions so that all the concepts that could be on the real test are covered. Usually, if the textbook does not change, I use the same *Example Tests* for 2 or more semesters before I change them. A copy of a College Algebra *Example Test 1* that I have used for the last two years starts on the next page. A copy of other *Example Tests* and *Example Finals* that I am currently using will be available shortly on my web site.

The questions on the *Example Tests* give my students questions, at the correct standard, to practice on. The solutions I provide to some of the questions show my students how to present their own solutions, how to obtain partial credit throughout a solution, and what to write to ensure full credit for a solution when the *TI-83 calculator* is used.

My students have always ranked *Example Tests* as the most important technique of all; but now, when **Peer Responsibility** is used in a course, the *Example Tests* have a very important additional role. If the instructor does not have a Teaching Assistant then the instructor must check all the solutions and marking in the workbook. The questions for the workbook must be selected with care so that checking the workbook does not become an impossible task that dominates the semester. This discussed in Chapter 4. In short, there cannot be too many questions per student per session! So I use the questions on the *Example Tests* as a source of further practice, **BUT** these questions do **NOT** have to be marked by the instructor.

On each *Example Test*, I tell my students which questions I intend to complete in class and then tell them to divide the remaining questions between the partners, complete them in their own time, and discuss their solutions with their partners. I make it very clear that all the topics and concepts that could appear on the real test are covered in the *Example Test* and the workbook problems. To reinforce their importance, I tell my students that it is essential that they complete the Example Tests because, when I mark the real tests, I can tell which students completed the questions on the Example Tests and which ones did not. This strategy forces students to complete the questions on the Example Test without using more of the instructor's time. I make sure they know that if they need help, I am just a phone call away. If there are difficulties, I sort them out either in class, in *Additional Voluntary Tutorials*, or in my office hours. *Completing the workbook gets students working together*. It effectively acts like a catalyst, so that dividing the questions, on an Example Test, between the partners, solving them and discussing them, is not a new idea.

M105 COLLEGE ALGEBRA *FALL 2001*

EXAMPLE TEST 1

from

Mike Bankhead

This ***Example Test 1*** consists of **TWO** parts. **Part A** is a complete **Test 1**, taken by a class of students in the past. Students who took this test had *50 minutes* to complete ***ALL*** questions. **Part B** consists of some additional questions that could be similar to questions on the test you will take.

NONE OF THE QUESTIONS ON THIS EXAMPLE TEST WILL APPEAR ON THE TEST YOU WILL ACTUALLY TAKE.

PART A

TEST 1 M105O - COLLEGE ALGEBRA FALL 2001

SHOW YOUR WORKING

EXPLAIN WHAT YOU ARE DOING

1) In the following problem, perform the indicated operations and simplify

$$8x - 4\{-[8x - 4(3 + 2x)] - 6(3x - 2) - 4\}$$

(***Similar to Section 1.2 Qu. 32 P22***)

---

2) A shopping bag contains apples, oranges, lemons, and pears. If **x** is the number of lemons and there are **5** more oranges than lemons, **2** less pears than oranges, and three times as many apples as oranges, write an algebraic expression, in its simplest form, in terms of **x** that represents the number of fruit in the shopping bag. If there are **11 oranges**, how much fruit is there in the shopping bag?

(***Similar to Section 1.2 Qu. 65 P22***)

---

3) Factor completely the following expression relative to the integers :

$$4(x-3)^3(x^2+2)^3+6x(x-3)^4(x^2+2)^2$$

(*Section 1.3 Qu. 50 P32*)

---

4) Perform the indicated operations and reduce the answer to the lowest terms.

$$\left(\frac{x}{x^2-16}-\frac{1}{x-4}\right)\div\frac{4}{x+4}$$

(*Section 1.4 Qu. 37 P41*)

PART B

5) Given the sets of numbers **N, Z, Q, R,** and **C**, indicate to which set(s) each of the following numbers belong :

a) -11 b) $\sqrt{2}$ c) $-2+5i$ d) $\frac{29}{111}$

(*Similar to Section 1.1 Qu. 49 P11*)

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6) If $A=\{1, 2, 3, 4\}$ and $B=\{2, 4, 6\}$, find $\{x \mid x \in A \text{ or } x \in B\}$. (*Section 1.1 Qu. 55a P11*)

---

7) Perform the indicated operations and simplify

$$5b-3\{-[2-4(2b-1)]+2(2-3b)\}$$

(*Section 1.2 Qu. 32 P22*)

---

8) Perform the indicated operations and simplify

$$(y-1)(y+1)+(y-3)(y+4)$$

(*Section 1.2 Qu. 42 P23*)

---

9) A parking meter contains *nickels*, *dimes*, and *half-dollars*. There are **6** more *dimes* than *nickels*, and **3** less *half-dollars* than *dimes*. Write an algebraic expression that represents the value of all the coins in the meter in **cents**. *Simplify the expression*. If there were **8 dimes**, what is the total value of the coins? (***Similar to Section 1.2 Qu. 65 P23***)

10) Perform the indicated operations and simplify

$$-3x\{x[x - x(2 - x)] - (x + 2)(x^2 - 3)\}$$

(Section 1.2 Qu. 55 P23)

---

11) Factor the expression $3z^2 - 28z + 48$ completely relative to the integers. *(Section 1.3 Qu. 30 P31)*

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12) Factor the expression $6m^2 - mn - 12n^2$ completely relative to the integers.

(Section 1.3 Qu. 36 P32)

---

13) Factor the expression $y^2 - 2xy + x^2 - y + x$ completely relative to the integers.

(Section 1.3 Qu. 68 P32)

---

14) Perform the indicated operations and reduce the answer to the lowest terms.

$$\left(\frac{3}{x-2} - \frac{1}{x+1}\right) \div \frac{x+4}{x-2}$$

(Section 1.4 Qu. 38 P41)

---

15) Perform the indicated operations and reduce the answer to the lowest terms.

$$\frac{3}{y+2} + \frac{2}{y-2} - \frac{4y}{y^2-4}$$

(Section 1.4 Qu. 17 P41)

---

16) Reduce the following expression to its simplest form, writing your answer using **positive exponents** only.

$$\frac{32n^5n^{-8}}{24m^{-7}m^7}$$

(Section 1.5 Qu. 30 P50)

---

3) NO TIME LIMIT ON TESTS, INCLUDING THE FINAL (AS FAR AS POSSIBLE)

Another thing that I have found reduces anxiety in the real test is to ensure that there is plenty of time for each student to complete and check their test. On all past evaluation forms 1 represented NO HELP AT ALL and 5 represented ESSENTIAL. This technique always obtained 5 out of 5 from every student so I stopped evaluating it. It is so simple to do and is so important to my students, that now I always write the in-term tests so that, as far as possible, my students are not competing against the clock. There is never a problem having no time limit for the Final.

4) TAKE ONE SHEET OF PAPER INTO A TEST (INCLUDING THE FINAL)

I permit each student to take ***One Letter Size Sheet of Paper*** into any test of mine including the Final. They can write anything they like on both sides of the sheet. This is to reduce the anxiety associated with taking a Maths test. From an academic standpoint, in order to decide what to put on the piece of paper, they have to read the book - which is exactly what I want them to do. From the student's point of view, it would seem that it is comforting to have some information that they have put together with them. They can write *anything they like* on both sides of the piece of paper, so cheating is not possible. **However, if two or more students are caught cheating, they could claim that they worked together and brought similar or identical solutions in with them on their one sheet of paper. In view of this possibility, I have each student put their names on this sheet and I collect them at the end of the exam with their scripts. I always mark and return the scripts to my students**

BUT I NEVER RETURN THE ONE SHEET TO ANY STUDENTS – JUST IN CASE!

You must state clearly that the piece of paper must be letter sized. When I first started using this technique, I omitted to tell my students the size permitted, and one student brought a huge piece of poster board into the test. Yet another brought in a roll of white wallpaper! It is quite common for students to use a copier to substantially reduce information before pasting it onto their one piece of paper. I have even seen students having to use a magnifying glass to see the print on their one sheet! I have no objection to them doing this.

Note that if you choose to use this technique, the format of the questions on tests must change. For example, you cannot ask for definitions or proofs in any test because some students may have brought it with them on their one sheet and some may not. This would give those students, who were just lucky enough to put it on their one sheet, an advantage. I write questions that require my students to ***demonstrate*** that they ***understand*** and know ***how to use*** the definitions and proofs and understand the concepts. In consequence, my test questions overall are far more demanding than they were before I started using this technique.

I have had some adverse comments from other faculty about this technique. They object to the fact that my students do not have to memorize formulae. *However, I never require my students to memorize formulae* (see *Technique 6*). Moreover, I actually tell students not to waste space on their one sheet with formulae, because any formula they need, will be written on the blackboard or at the end of a test. I believe it is worrying for a student, who is already poor at, and perhaps even a little frightened of, Maths, to be forced to memorize formulae. If they were working in industry and needed to use a particular formula, it is far more important that they know *when* they need to use it, and *where* to find it, than to commit a formula to memory and perhaps not know its purpose.

5) ALL QUESTIONS ON THE TESTS STRAIGHT FROM OR SIMILAR TO QUESTIONS IN THE TEXTBOOK OR ON THE EXAMPLE TESTS

The objective of this technique is to encourage students to solve more questions from the textbook so they get additional practice. If they solve more questions they might complete one or more of the questions, or questions similar to those, that are actually on the test. Sometimes I make various changes to a question I intend to put on a test (I warn them about this possibility). I do this because students sometimes bring in the solutions to some of the questions in the textbook on their one sheet of paper (*Technique 4* above). This is perfectly permissible, but obviously I do not want the solution to a test question copied from their one sheet of paper.

6) NEVER REQUIRE STUDENTS TO REMEMBER FORMULAE BUT MUST KNOW WHEN TO USE A FORMULA AND, IF THE FORMULA IS FORGOTTEN, MUST KNOW WHERE TO FIND IT.

If a question needs a formula then it will be at the end of the test. If, during the test, a student requests a formula, I put it up on the blackboard and draw every student's attention to it. I *never* require my students to memorize a formula. To some students forcing them to memorize a formula is frightening, and to my mind it is totally unnecessary. It is far more important for a student to know which formula is needed to obtain the correct solution, and then know where to find it, if they cannot remember it.

7) GRADED BONUSES ON ALL TESTS

The objective of this technique is to make my students ***think*** throughout a test. This technique has always been high on my student evaluations. The comments I have received and the overall response to this technique suggests that it does indeed cause students to think more deeply about the questions that they have to answer on a test.

What I give bonuses for depends on a variety of things. I expect more from my students as the course progresses – hence **graded** bonuses. On the first test, I may give one bonus point for putting a complete title on a graph or the equation of a line alongside the drawn line. On future tests the title and the equation by the line are expected, so there would be no bonuses available. In **Test 1**, if they solve a problem, then carry out the relevant check, I may give a bonus, but checking an answer is expected on future tests. I want them to be constantly thinking about ways to gain bonuses so they constantly think about, not just the questions on the test, but also the underlying concepts and related topics.

For each test, I create a complete marking scheme that includes marks for everything that must be included in a solution to obtain full marks for the question. After marking every student's script, I can then award bonuses based on anything extra that has been included in a solution. To gain a bonus or bonuses, anything extra must be relevant to the question. I have had students in the past, who were unable to answer the question on the test, invent a question of their own, then proceed to answer it, expecting to gain bonuses. Obviously, they gained nothing. I do not give bonuses for an answer that could have been brought in on their one sheet. In fact, I rarely give any marks for the correct numerical answer, the marks are for how they got to it. I am much more interested in an answer that shows they understand the underlying concepts. Something that could have been memorized, perhaps without understanding, would not gain a bonus mark. As the course progresses, I find that students improve their understanding of the underlying concepts, so they are better able to gain bonuses during tests.

8) PROVIDE INFORMATION IN EXCHANGE FOR MARKS DURING ANY TEST

Frequently, a question in a test will require a student to create an equation from a verbal description. If a student cannot create the equation, then it is impossible to complete the rest of the question. For example, if there are 6 marks for creating an equation from a verbal description, and 18 marks for completing the problem, if he or she could not create the equation, all 24 marks would be lost (6+18). It is possible that the student could obtain the 18 marks if he or she was given the required equation. In short, the instructor is not getting a true picture of the student's capabilities. To avoid this situation, if a student is stuck in a test, they can ask for the equation or whatever they need to get "unstuck". I then write the equation into their script in red pen with the appropriate lost marks alongside. In the above example, I would insert the equation into the script with –6 alongside with a red pen. This means they have lost 6 marks, but they have a chance of gaining some or al of the other 18 marks. **I also make a separate note of exactly what I did to their script during the test – as a precaution, in case my insertions disappear into a black hole!**

3.2 TECHNIQUES TO PROMOTE HOPE THROUGHOUT THE COURSE

9) UNLIMITED BONUSES AVAILABLE FOR THE SOLUTIONS IN THE WORKBOOK (IT IS POSSIBLE TO CANCEL OUT A POOR ASSIGNMENT OR TEST MARK WITH THESE BONUSES)

THESE BONUSES ARE RELATED TO A STRATEGY THAT I REFER TO AS PEER RESPONSIBILITY. IT IS DISCUSSED IN CHAPTER 4

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10) 90% OR MORE IN FINAL RULE FOR ELIGIBLE STUDENTS *(PROVIDED ALL ASSIGNMENTS/PROJECTS AND THE WORKBOOK ARE COMPLETE)*

The 90% rule is very simple. About four or five weeks from the end of the semester, I tell my students that if they obtain *90% or more in the Final*, I will give them an **A** for the course, whatever their current grade. *Providing they have completed all the assignments/projects and all the solutions and marking in the workbook.* The objective is to give hope to those who are in trouble, and to those who may be capable of doing the work but are not applying themselves. Clearly a student having a **D** or **C** is most unlikely to obtain 90% or more in the Final. In fact only two students (out of approximately 400) who were holding a **D** or **C** prior to the Final have ever obtained 90% or more in the Final. However, I believe that hope is one of our most powerful emotions, and this rule does have a very positive effect on many students.

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11) TOP 25% IN FINAL RULE FOR ELIGIBLE STUDENTS *(PROVIDED ALL ASSIGNMENTS/PROJECTS AND THE WORKBOOK ARE COMPLETE)*

The 90% rule has always been very popular among my more optimistic students. So I created the *Top 25% in Final Rule*. I use 25% because when I checked back over the years, I noticed that I usually gave more than 25% of a class **A**'s. So if any student ends up in the top 25% in the Final and he or she does not have an **A** for the course, I give them an **A** for the course. *Providing they have completed all the assignments/projects and all the solutions and marking in the workbook. Note that when calculating the number of students who will get* ***A's****, I take 25% of those students who are eligible in a class,* ***NOT*** *25% of all those students taking the Final.* This means that any student who is not an **A** student prior to the Final has to do better than the top 25% of the class, and, in my view, if they do, they deserve an **A**! The rationale is the same as for the *90% or More in Final Rule* and this technique is just as popular. A less able student is unlikely to beat the very able students in a class, nevertheless, this technique does have a very positive effect on some of my students. Recently one of my students who had only turned up to only five classes during an entire term, thought that she would succeed because of this rule or the 90% Rule. I was and still am amazed at her optimism! Hope springs eternal, so it would seem!

3.3 TECHNIQUES TO IMPROVE STANDARDS

12) *PEER RESPONSIBILITY* - COMPLETING SETS OF QUESTIONS FROM THE TEXTBOOK AND MARKING THE QUESTIONS OF *ONE* PARTNER IN THE WORKBOOK.

PEER RESPONSIBILITY **IS DISCUSSED IN CHAPTER 4**

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13) ANY NUMERICAL ANSWER REQUIRES A SENTENCE CONTAINING IT IN THE CONTEXT OF THE QUESTION.

Some years ago, I became uncomfortable giving a student as many as 10 marks for obtaining the correct numerical answer to a question using a calculator. It occurred to me that I could probably train the average monkey to press the correct keys on a calculator and get the right number. However, the monkey would not know the meaning of the number, and I felt that some of my students did not know either. So I began to insist that students showed me that they knew the meaning of the number they had calculated by including it in a sentence in terms of the question. I soon discovered that many students did not know the meaning of the number they had obtained on their calculator screens.

Consider the following example from a past exam, the exam question was :

> ***Dan wants $2,000 now, from a bank, to be repaid 18 months from now. How much will the repayment be if the discount rate is 15%?***

The correct numerical answer is $2,580.65. Five years ago, this answer would have earned this student 10 marks. However, the sentence from this student was :

> ***In 18 months time, with a discount rate of 15%, the bank will pay Dan $2,580.65.***

(*I am still trying to locate this bank : and when I do I won't tell anyone – it's mine!!!*).

Students' who write a correct sentence with the correct numerical answer in it, but with no working to back it up, do not get the marks allocated to the correct answer in a sentence. They must show all of the working to gain credit for their answer (I never forget that they bring one sheet of paper in with them!). In addition, I frequently warn my students during the course, that ***if I cannot read it – it is wrong!***

I have asked students for their opinion on writing a sentence for any numerical answer. Last term one of my students said "Having to write a sentence helps me understand the ideas". I was very pleased with this response, although there are certainly students who do not share this view! I now feel that if a calculator is used in any course, checking that students do understand the meaning of the number that has appeared on the calculator screen is essential.

14) SHOWING STUDENTS ERRORS MADE BY PAST STUDENTS

Throughout every course I teach, I show my students errors made by students in past courses. The obvious objective is to stop my current students making the same errors, but I also do it to broaden the knowledge and understanding of the topic we are studying and to cause discussion between my students and me at the time and when I ask my students to tell me what the common error is in that topic later on in the course. I include the following two examples.

Example 1

I had no trouble selecting this Statistical error as an example for this paper because it is so common. The most powerful tool we use to test the normality of a distribution with *mean* $\bar{x}$ and *standard deviation* s, is the *Normal Quantile Plot* (***NQP***). If the points on an ***NQP*** lie close to a straight line, the distribution can be modeled by the normal distribution, with $\mu = \bar{x}$ and $\sigma = s$. *Outliers* appear as systematic deviations away from the overall pattern of the plot. The **z-values** used in an **NQP** depend only on the number of observations in the distribution. So if every member of the class has collected 50 observations, the **z-values** will be the same for every student in the class, no matter what the measurements represent.

I show my students how to use the function ***invNorm***, on the TI-83 calculator, to find the **z-values** they need for the **NQP**. However, since this process is very tedious, when I require my students to draw an **NQP** on paper, I tell them to obtain the **NQP** on the display screen and then use the ***TRACE*** key to find the required **z values**. Since the **NQP** is one of the graphs available on the ***STAT PLOT*** key, this process is quite simple, although rather tedious.

Early on in most Statistics textbooks, students are introduced to the formula

$$z = \frac{(x-\mu)}{\sigma} \qquad \bullet\bullet\bullet\bullet\ 1)$$

The value for **z** calculated by this formula is called the **z-score** of **x**. Unfortunately, students use this formula to find the **z-score** for each of their observations, and then plot a scatterplot of the **z-scores** against their observations, incorrectly believing that the resulting graph is the ***NQP*** for their distribution. They always find that every one of their observations is ***precisely*** on a straight line. Of course!!! And they always will be, no matter how many outliers are actually present in the distribution! To add to the confusion, the textbook we use has the **z-value-axis** labeled ***z-score*** on every ***NQP*** drawn in the textbook.

I demonstrate this error to my students using Babe Ruth's home run data as the distribution. It is shown in list **L1** in **Table 1**, except I have changed his greatest performance of *60 home runs* to *120 home runs* so that there is a clear outlier in the distribution. List **L2** contains the **z-values** that produce the correct **NQP** on the TI-83 calculator. These values were obtained using the **TRACE** key, on the TI-83 calculator, after displaying the **NQP** on the display screen. List **L3** contains the **z-scores** of each observation using **Equation 1** above. The instruction **(L1−$\bar{x}$)/s < STO > L3**, where $\bar{x}$ and **s** are the mean and standard deviation of the observations in list **L1**, calculates the **z-scores** for each observation in list **L1** and stores them into list **L3**.

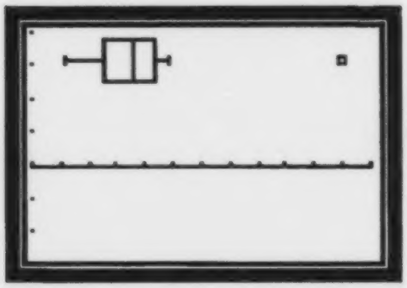
TABLE 1

BABE RUTH'S HOME RUNS LIST L1	CORRECT Z-VALUES FROM NQP ON TI-83 LIST L2	VALUES OF Z USING Z-SCORE FORMULA LIST L3
22	−1.8339	−1.1549
25	−1.2816	−1.0213
34	−0.9674	−0.6205
35	−0.7279	−0.5760
41	−0.5244	−0.3088
41	−0.3407	−0.3088
46	−0.1679	−0.0861
46	0	−0.0861
46	0.1679	−0.0861
47	0.3407	−0.0416
49	0.5244	0.0475
54	0.7279	0.2702
54	0.9674	0.2702
59	1.2816	0.4929
120	1.8339	3.2094

The graphs shown in *Figures 1*, *2*, and *3* were obtained directly from the TI-83's display screen by linking my **TI-83** to my **PC** using a *graphing link*. The window variables for each graph are identical. The observations in each graph, list **L1** above, are plotted on the **x-axis**. In *Figures 2* and *3*, the values in lists **L2** and **L3** are plotted on the **y-axis**.

A **TI-83** *modified boxplot* of Babe Ruth's distribution, shown in *Figure 1*, makes it clear that 120, the box on the extreme right of the graph, is an outlier.

FIGURE 1



The correct **NQP** for this distribution is shown in *Figure 2*. The observation 120 is clearly an outlier. This graph can be displayed by either using the **NQP** option on the **STAT PLOT** key, or by using the scatterplot option, plotting **L2** against **L1**. *Figure 3* is a scatterplot of the **z-scores** in **L3** against the observations in **L1**. All 15 observations are precisely on a straight line, even though 120 is an outlier.

FIGURE 2

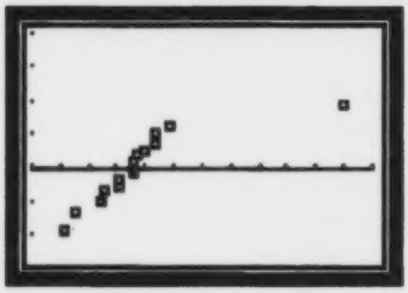
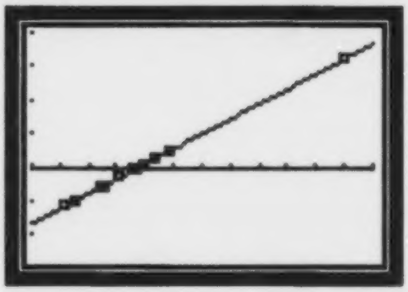


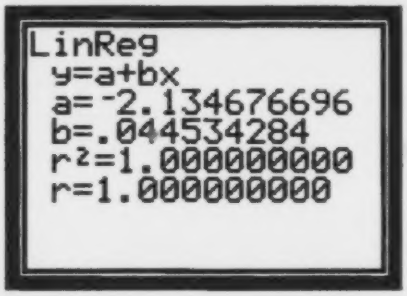
FIGURE 3



The straight line in *Figure 3* is the *least squares line*. Every observation is precisely on this line because **Equation 1** is the equation of a straight line with *slope* $\frac{1}{\sigma}$ and *y-intercept* $-\frac{\mu}{\sigma}$ (for this problem the slope is $\frac{1}{s}$ and the y-intercept is $-\frac{\bar{x}}{s}$). Clearly, when an **x** value is entered into **Equation 1**, the value calculated is precisely on the straight line $z = -\frac{\bar{x}}{s} + \frac{1}{s}x$

When I ask my students to show that all 15 points are on this straight line, they know what to do! *Figure 4* is the output from the function **LinReg(a+bx) L1, L3**.

FIGURE 4



```
LinReg
 y=a+bx
 a=⁻2.134676696
 b=.044534284
 r²=1.000000000
 r=1.000000000
```

For list **L1** : $\bar{x}$ = **47.93333333** and **s = 22.45461030** and thus

$$a = -\frac{\bar{x}}{s} = -2.134676696 \text{ and } b = \frac{1}{s} = 0.44534284 \text{ also } r = 1$$

My students know that the **correlation coefficient**, **r**, is only exactly **1** when all the observations are precisely on the *least squares line*!

Example 2

Another common Statistical error involves the *1.5 x IQR Criterion for Outliers*. It states that an observation is a suspected outlier, if it falls more than *1.5 x IQR* above the third quartile or below the first quartile (the acronym **IQR** stands for **I**nter**q**uartile **R**ange). The formulae for these test values are :

$$Q_1 - 1.5 \times IQR \qquad \text{and} \qquad Q_3 + 1.5 \times IQR$$

A common error is to omit the **1.5** from these formulae, so when I write these formulae on the blackboard, I use red chalk for it (as shown above).

Example 3

The most common error in my College Algebra courses involves the negative sign outside a bracket. Students forget to change the sign of the terms inside the brackets after the first when removing the brackets. I make a negative sign outside a bracket red on the blackboard or whiteboard until the brackets are removed. This is illustrated when simplifying the expression below. Since this paper is in black and white the R below a negative sign indicates that it is red.

$$(4x - 5)(3x + 2) - 6(x^2 - (3x - 2))$$

I would use the **Arrow Method** to expand the first pair of brackets and then systematically remove the brackets changing a red negative sign to black, as the brackets are removed. Later in the course, I put a black negative sign where a red one should be, and let the students tell me to replace it with a red one.

$$\begin{aligned}(4x - 5)(3x + 2) \underset{R}{-} 6[x^2 \underset{R}{-} (3x - 2)] &= 12x^2 - 7x - 10 \underset{R}{-} 6[x^2 \underset{R}{-} (3x - 2)] \\ &= 12x^2 - 7x - 10 \underset{R}{-} 6[x^2 - 3x + 2] \\ &= 12x^2 - 7x - 10 - 6x^2 + 18x - 12 \\ &= 6x^2 + 11x - 22\end{aligned}$$

---

15) BONUS MARKS FOR ATTENDANCE DURING THE LAST FOUR WEEKS OF THE COURSE

Quite often during the last few weeks of a course, I noticed that some of my students disappeared. For example, during one semester, when the sun came out, the golfers were gone. To encourage students to keep coming I award 2 marks for attendance. I do not do it every time we meet, so my students never know when I will send the attendance register around. If a lot of students are missing, 40% or more, I might give 5 marks for attendance. While I tend to use this towards the end of a semester, I sometimes check the attendance at other times without warning. The evidence shows that it does have a positive effect on some students.

I print a copy of the *Attendance Register* in the *Marks Register workbook* and pass it round. Students put a 1 alongside their name. At the end of the course, I put the values into the Attendance Register worksheet so that the totals are transferred to the **Tot Bon** (Total Bonuses column) of the Marks Register.

3.4 TECHNIQUES THAT HAVE CHANGED MY STYLE OF TEACHING

16) USE THE TEXTBOOK AS A SET OF NOTES TO MINIMISE THE AMOUNT OF WRITING STUDENTS DO IN CLASS.

I use the textbook as if it was a set of notes. I recommend that my students buy a highlighter pen and highlight important points, ideas, definitions, theorems etc. as we work through the textbook because I read definitions and quote important points etc., so that they can then hear and **see** them at the same time and I do not want writing things down to distract them.

I make transparencies of theorems, solutions, and parts of the textbook I want to discuss and put them on the OHP. I can then discuss the topic while referencing the transparency or the image on the screen using a laser pointer. For example, I frequently project a theorem onto the screen, while solving a problem connected with it, and reference different parts of the theorem, using a laser pointer, as I solve the problem. *Example 1*, below, is an example of a transparency that I use (I make it as big as possible on the transparency). My students can look, listen and ask questions. They do not have to take notes, because the content of this box is in the textbook we use. Another major advantage is that I can reference whatever is on the screen or overhead projector using a laser pointer, while walking around the class answering questions from individual students.

Example 2, on the next page, is an example of a transparency that I use on the overhead projector in my College Algebra course. I can solve problems on the blackboard while referring to each step on this slide using a laser pointer. If I need to enhance a pre-prepared slide that is on the overhead projector, I lay a blank slide over it and write onto it with an erasable marker (I clean the blanks later). This leaves the original undamaged. I am still facing the class when I am doing this, which allows me to interact far more efficiently with my students. Using a laser pointer also allows me to continue asking questions about the content of the slide while moving around the classroom.

Example 1 : A Box in Moore and McCabe's Statistics Textbook

Probability Rules

Rule 1. The probability **P(A)** of an event **A** satisfies $\mathbf{0 \leq P(A) \leq 1}$.

Rule 2. If **S** is the sample space in a probability model, then $\mathbf{P(S) = 1}$.

Rule 3. The complement of any event **A** is the event that **A** does not occur $\mathbf{A^c}$. The **complement rule** states that

$$P(A^c) = 1 - P(A)$$

Rule 4. Two events **A** and **B** are disjoint if they have no outcomes in common and so never occur simultaneously. If **A** and **B** are disjoint,

$$P(A \text{ or } B) = P(A) + P(B)$$

This is the **addition rule for disjoint events**.

The objective of this strategy is to minimize the amount of time my students spend copying material off the board. I know from my own experiences as a student, that I can copy from the board without thinking about what it means (I can also write on the board while thinking about something else!). I do not want my students doing this. This approach also gives me more time to ask questions and maximizes the amount of time I have to interact with my students. This technique is closely related to *Technique 17*.

Example 2 - A College Algebra Slide

Strategy for Solving Word Problems

1. **Read the problem carefully-several times if necessary; that is, until you understand the problem, know what is to be found, and know what is given.**
2. **Let one of the unknown quantities be represented by a variable, say x, and try to represent all other unknown quantities in terms of x. This is an important step and must be done carefully.**
3. **If appropriate, draw figures or diagrams and label known and unknown parts.**
4. **Look for formulae connecting the known quantities with the unknown quantities.**
5. **Form an equation relating the unknown quantities to the known quantities.**
6. **Solve the equation and write answers to all questions asked in the problem.**
7. **Check and interpret ALL of the solutions in terms of the original problem - not just the equation found in step 5 - since a mistake may have been made in setting up the equation in step 5.**

17) MAKE AND USE TRANSPARENCIES OF GRAPHS, TABLES, RULES, ETC. SO TIME IS NOT WASTED DRAWING OR WRITING THEM ON THE BLACKBOARD.

I create transparencies of some of the diagrams, tables, and solutions from the textbook we are using and menus from the **TI-83**, so that I have more time to discuss the topic and to ask questions directly to the class. Also, the students do not waste time copying off the blackboard. This saves a lot of time during a lecture and students can listen to me and ask questions because they are do not have to take notes from the blackboard. These days many textbooks include a CD that has all the diagrams, tables, sets of data etc. in the textbook on it. If I am in a multi-media lab and the textbook we are using comes with a CD, I discuss the diagrams, tables etc. in the textbook after projecting them onto a large screen via the instructor's computer. Note that there are some diagrams that are best drawn on the board so students can see them being created. **Example 1** is an example of a table I copied from the Statistics book we use. I created it in **Word** ***and*** made an overhead transparency of it, so I could project onto the screen in a multi-media lab from my zip disk, or display it via the overhead projector if I was not in a multi-media lab.

Example 1 : A Table from Moore and McCabe's Statistics Textbook

YEARS OF SCHOOLING COMPLETED, BY AGE, 1995 (THOUSANDS OF PERSONS)

	AGE GROUP			
EDUCATION	**25 to 34**	**35 to 54**	**55 and over**	**TOTAL**
Did Not Complete High School	5,325	9,152	16,035	**30,512**
Completed High School	14,061	24,070	18,320	**56,451**
College 1 to 3 Years	11,659	19,926	9,662	**41,247**
College, 4 or More Years	10,342	19,878	8,005	**38,225**
TOTAL	**41,488**	**73,028**	**52,022**	**166,438**

I found that creating a slide for some of the **TI-83** menus speeds up the learning process. So I have created a number of slides for many of my courses. I can reference the slide using my laser pointer while solving a problem on the blackboard. **Example 2**, on Page 55, shows the transparency I use for one of the *TI-83* menus. It shows the **STAT TESTS MENU**. The yellow area is that part of this menu that is displayed after pressing the key sequence **<STAT>** ←. The green area shows the bottom half of this menu. The **P13.9** in the title of this transparency refers to the page number in the *TI-83 manual*.

For many classes I use the **TI-83** with an LCD projector that sits on top of the overhead projector. I found that after placing a blank transparency over the projector I can emphasize a graph(s) or some of the data projected onto the screen using colored projector pens. This makes the discussion that follows much easier for my students to follow. I am also facing the class when I am doing this, which allows me to interact far more efficiently with my students.

Example 2 - The STATS TESTS Menu on the TI-83 Calculator

STAT TESTS MENU (<STAT> ← - P13.9)

EDIT CALC TESTS	Pressing the **STAT** key allows you to select the **EDIT** menu (the *default menu*), the **CALC** menu, or the **TESTS** menu.
1 : Z - Test ...	**Test** for **1** μ , *known* σ *(Section 6.2)*
2 : T - Test ...	**Test** for **1** μ , *unknown* σ *(Section 7.1)*
3 : 2 – SampZTest ...	**Test** comparing **2** μ**'s** , *known* σ**'s** *(Section 7.2)*
4 : 2 – SampTTest ...	**Test** comparing **2** μ **'s**, *unknown* σ**'s** *(Section 7.2)*
5 : 1 – PropZTest ...	**Test** for **1** proportion *(Section 8.1)*
6 : 2 – PropZTest ...	**Test** comparing **2** proportions *(Section 8.2)*
7↓ Zinterval ...	**Confidence Interval** for **1** μ , *known* σ *(Section 6.1)*
8 : TInterval ...	**Confidence Interval** for **1** μ , *unknown* σ *(Section 7.1)*
9 : 2 – SampZInt ...	**Confidence Interval** for **2** μ**'s** , *known* σ**'s**
0 : 2 – SampTInt ...	**Confidence Interval** for **2** μ**'s** , *unknown* σ**'s** *(Section 7.2)*
A : 1 – PropZInt ...	**Confidence Interval** for **1** proportion *(Section 8.1)*
B : 2 – PropZInt ...	**Confidence Interval** for Difference of **2** Proportions *(Section 8.2)*
C : χ^2- Test ...	**Chi-Square Test** for **2-way** Tables *(Section 9.1)*
D : 2 – SampFTest ...	**Test** comparing **2** σ**'s**
E : LinRegTTest ...	**t-Test** for Regression Slope and ρ
F : ANOVA(...	One-Way Analysis of Variance *(Chapter 12)*

NOTE : This course does not cover items 9, D, and E (the items with blue descriptions)

18) USE COLORED CHALK OR COLORED MARKERS ON THE BOARD

I have used colored chalk on the blackboard for many years. This technique never does well in the evaluations and yet the comments I get from students on the evaluation forms make it quite clear that it is helpful during a lecture.

I use different colors for different things depending on the course. I make a list of the colors I use for different things in each course. Then if I do not teach the course for a while I have a reference list. For example, in a course involving differentiation, I use white chalk for the main working, red chalk for a derivative, yellow chalk for a second derivative, blue chalk for a rule i.e. the product rule etc. In College Algebra, the minus sign before a bracket is in red (for danger!). After I have done this a few times making sure my students are familiar with the danger, I stop doing it and ask my students what is missing. They usually tell me to change the white minus sign to a red minus sign. For a course involving computers, I use white chalk for the characters the computer puts on the screen, orange chalk for characters that must be typed in by the student etc. Students get used to the meaning of a particular color. It breaks up what is on the blackboard and makes it easier to pick off the derivative, a formula etc.

Another idea I found useful is to divide the blackboard into several vertical strips. For example, I might divide it into three parts. Then use the left part for terms and definitions using red chalk, the middle portion for main work, and the right portion for graphs drawn using different colors. I am frequently teaching a topic that I have taught hundreds times before, having to think about which color to use, helps me stay focused.

19) CREATE ALTERNATIVE METHODS FOR THOSE TOPICS THAT CAUSE DIFFICULTY

I found that many students had considerable difficulty with certain topics which could easily be modified to either simplify the approach or make routine what students had to do to obtain the correct solution(s). I simplified this type of topic by creating what I call an *Alternative Method*. The objective of an *Alternative Method* is to reduce "Maths Anxiety" by making it possible for any student, whatever their mathematical ability, to obtain the solution(s) to a type of problem that causes difficulty using the approach described in most textbooks. Of course, it is important that the *Alternative Method* does not obscure the underlying concept(s). To illustrate what I mean by an *Alternative Method*, I include four in this paper – two from College Algebra and two from Elementary Statistics. I call *Alternative Method 1* the ***Arrow Method***. It replaces **FOIL**, which I assume was invented by someone who hated students! I call *Alternative Method 2* the ***Guaranteed Factor method*** or **GFM** for short! *Alternative Method 3* and *4* are for Statistics courses. *Alternative Method 3* provides an overview of Chapters 6, 7, 8, and 9 in Moore and McCabe's Statistics textbook we use. *Alternative Method 4* involves a simple diagram that eliminates a common error.

ALTERNATIVE METHOD 1 - COLLEGE ALGEBRA

The Arrow Method

The **Arrow Method** is a method which, unlike **FOIL**, allows a student to multiply out any of the algebraic expressions shown on the next page using what I call **arrow sets**. The grey highlight in **Example 1** covers ***one* arrow set**. So **Example 1** has *two* arrow sets, one above the expression and one below, while **Example 3** has *three* **arrow sets**, one above and two below the expression. I draw each *arrow set* using chalk of a different color and write the resulting terms on the other side of the equal sign in the same color as the *arrow set*, before finally collecting up terms using white chalk. Even though the *arrow sets* below the expression in **Example 3** cross each other, there is no confusion because they are drawn using different colored chalk. Students frequently include the *arrow sets* in tests, even in the final! Some even draw them in color! I spent some time testing various ways of drawing the *arrow sets* and found that lines drawn at right angles were the most effective.

The Arrow Method

Notation

Color of Chalk Used for Arrow Sets (using different styles of lines)

Red Chalk = —————— Yellow Chalk = ═ ═ ═ Green Chalk = - - - -

Color of Chalk or Markers Used for Characters (using different fonts)

Red Chalk = $\mathbf{10x^2 - 35x}$ Yellow Chalk = $\mathit{4x + 14}$ Green Chalk = $21x+14$ White Chalk = $7x+2$

Arrow Set

1) $(5x - 2)(2x - 7) = \mathbf{10x^2 - 35x} - \mathit{4x + 14}$

$= 10x^2 - 39x + 14$

---

2) $(7x + 2)(x^2 + 3x - 9) = \mathbf{7x^3 + 21x^2 - 63x} + \mathit{2x^2 + 6x - 18}$

$= 7x^3 + 23x^2 - 57x - 18$

---

3) $(2x^2 - 5x + 7)(3x + 2) = \mathbf{6x^3 + 4x^2} - \mathit{15x^2 - 10x} + 21x + 14$

$= 6x^3 - 11x^2 + 11x + 14$

---

4) $2x^3(3y + 2z) = \mathbf{6x^3y + 4x^3z}$

ALTERNATIVE METHOD 2 - COLLEGE ALGEBRA

The Guaranteed Factor Method (GFM)

Many students have difficulty finding the two linear factors with integer coefficients of a second-degree polynomial (if they exist) i.e. finding the factors of a second-degree polynomial *relative to the integers*. The **Guaranteed Factor Method** uses a program, input by a student into the **TI-83** calculator, to find these factors for any second-degree polynomial of the form $\mathbf{Ax^2 + Bx + C}$. For example, if the two linear factors with integer coefficients of the second-degree polynomial $\mathbf{12x^2 + 7x - 10}$ are required, then this method will let *any* student find the expression $\mathbf{(3x-2)\,(4x+5)}$. The output from the program will also make it clear, if the polynomial **cannot** be factored relative to the integers. The following program, called **QUADPROG**, must be entered into the calculator first.

```
PROGRAM:QUADPROG
:Prompt A,B,C
:(-B+√(B² – 4AC))/
(2A)→P
:(-B–√(B² – 4AC))/
(2A)→Q
:Disp "ZEROS ARE
",P▶Frac,Q▶Frac
```

The following procedure finds the *roots* of $\mathbf{12x^2 + 7x - 10 = 0}$ (or the *zeros* of $\mathbf{12x^2 + 7x - 10}$) :

Step 1 $\mathbf{(3x-2)\,(4x+5) = 0}$

Step 2 then either $\mathbf{(3x-2) = 0}$ or $\mathbf{(4x+5) = 0}$

Step 3 and thus either $\mathbf{x = \frac{2}{3}}$ or $\mathbf{x = -\frac{5}{4}}$

Step 1 contains the factors of the quadratic function $\mathbf{12x^2 + 7x - 10}$ relative to the integers. It is this step that students have difficulty completing. When $\mathbf{A = 12}$, $\mathbf{B = 7}$, and $\mathbf{C = -10}$ are entered into **QUADPROG** the output is **Step 3**. Students can then proceed backwards to **Step 1** to obtain the factors of the quadratic function relative to the integers i.e.

Step 3 Output from **QUADPROG** : $\mathbf{x = \frac{2}{3}}$ or $\mathbf{x = -\frac{5}{4}}$

Step 2 then either $\mathbf{(3x-2) = 0}$ or $\mathbf{(4x+5) = 0}$

Step 1 $\mathbf{(3x-2)\,(4x+5) = 0}$

Therefore $\mathbf{(3x-2)}$ and $\mathbf{(4x+5)}$ are the factors of the quadratic function $\mathbf{12x^2 + 7x - 10}$ relative to the integers. Now, using **QUADPROG**, every one of my students can find the factors of any quadratic function relative to the integers. During my *College Algebra* course last semester, one of my students said "***QUADPROG** is so cool*". This must be the ultimate accolade!

ALTERNATIVE METHOD 3 - ELEMENTARY STATISTICS

COMPARING AND CONTRASTING CHAPTERS 6, 7, 8, AND 9

CHAPTER 6

Quantitative Variables
μ - unknown
σ - known (***NOT*** realistic)
Normal Distribution

6.1 Confidence Intervals (CI)

Confidence Interval Formula :

$$\bar{x} \pm z^* \frac{\sigma}{\sqrt{n}} \quad \text{P422}$$

CI - Ex. 6.2, 6.3: STM$_7$

Sample Size Formula :

$$n = \left(\frac{z^* \sigma}{m} \right)^2 \quad \text{P425}$$

Sample Size - Ex. 6.5

6.2 Tests of Significance (ToS)

H_0 - Null Hypothesis P438
H_a - Alternative Hypothesis P438

One-Sided and Two-Sided Tests

P-Value

Ex. 6.10, 6.11, 6.12 - STM$_1$

6.3 Use and Abuse of Tests

STUDENTS READ THIS SECTION

6.4 Power and Inference

Power - Ex. 6.17, 6.19
Type I Error - Ex. 6.20
Type II Error - Ex. 6.20

CHAPTER 7

Quantitative Variables
μ - unknown
σ - unknown
t-Distribution
df (degrees of Freedom)

7.1 One-Sample t-Procedures

Confidence Interval Formula :

$$\bar{x} \pm t^* \frac{s}{\sqrt{n}} \quad \text{P494}$$

CI - Ex. 7.1 : STM$_8$

Test of Significance

P-Value - Ex. 7.2, 7.3 : STM$_2$

(One Sample t-Test)

P-Value - Ex. 7.7

(Matched Pairs t Procedures)

7.2 Comparing Two Means

Confidence Interval Formula :

$$(\bar{x}_1 - \bar{x}_2) \pm t^* \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}} \quad \text{P529}$$

CI - Ex. 7.15 : STM$_0$

Test of Significance

P-Value - Ex. 7.14 : STM$_4$

(Two-Sample t Procedures)

CHAPTER 8

Categorical Variables
unknown proportion - p
Normal Distribution

8.1 Single Proportion

Confidence Interval Formula :

$$\tilde{p} \pm z^* SE_{\tilde{p}} \quad \text{P587}$$

CI - Ex. 8.1, 8.4 : STM$_A$

Test of Significance

P-Value - Ex. 8.2, 8.3 : STM$_5$

(Single Proportion)

8.2 Comparing Two Proportions

Confidence Interval Formula :

$$(\hat{p}_1 - \hat{p}_2) \pm SE_D \quad \text{P589}$$

CI - Ex. 8.8 : STM$_B$

Test of Significance

P-Value- Ex. 8.9 : STM$_6$

(Comparing Two Proportions)

CHAPTER 9

Categorical Variables

9.1 Inference for Two-Way Tables

[redacted]

Test of Significance

P-Value - Ex. 9.15 : STM$_C$

NOTE - STM is an acronym for TAT ESTS ENU. A menu on the TI-83 calculator.

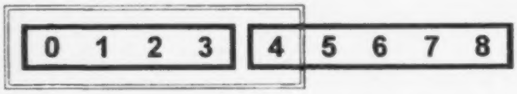
ALTERNATIVE METHOD 4 - ELEMENTARY STATISTICS

If **X** is **B(8, 0.25)**, then the TI-83 function **binomcdf(8,0.25k)** finds **$P(X \le k)$**, where **k=0(1)8**. For example :

$$P(X \le 3) = P(X = 0) + P(X = 1) + P(X = 2) + P(X = 3) = \text{binomcdf}(8, 0.25, 3)$$

Most of my students do not have trouble using the function **binomcdf(** when the required probability involves the symbol $\le$. However, when the required probability involves the symbol $\ge$, the common error is to use the expression **1 – binomcdf(n, p, k)** with **k** instead of **(k – 1)**. For example, if **$P(X \ge 4)$** is required, many students will calculate the value of the expression **1 – binomcdf(8, 0.25, 4)**, believing that this is the correct probability, when, in fact, the expression **1 – binomcdf(8, 0.25, 3)** is the correct probability.

I use the following diagram to show my students the difference between these two expressions. I draw the boxes around the numbers, in the diagram below, using chalk or markers of the same color. The row of numbers are the values that **X** can take. In fact they form the top row of the **probability distribution** for this problem. **$P(X \ge 4)$** is the sum of the probabilities for the values of **X** in the **red** box (the box around 4 to 8).



Since **binomcdf(8, 0.25, 3)** is the sum of the probabilities for the values of **X** in the **blue** box (the box around 0 to 3).

$$P(X \ge 4) = 1 - \text{binomcdf}(8, 0.25, 3)$$

The function **binomcdf(8, 0.25, 4)** is the sum of the probabilities for the values of **X** in the **green** box (the box around 0 to 4) so the expression **1 – binomcdf(8, 0.25, 4)** is **$P(X \ge 5)$** (or **$P(X > 4)$**) ***NOT*** **$P(X \ge 4)$**.

This diagram makes it possible for every student in my classes to understand why the error occurs and how to prevent it. I encourage them to draw something like this in tests to ensure they obtain the correct answer, and some of them do.

There are many topics that cause students difficulty, and hence Maths Anxiety, that can be modified and simplified. I have always found that creating an *alternative method* to overcome a problem is a lot of fun, even though some of them can take a lot of time to create and test. However, I have always found that this extra time is well spent. If there was a *first law of teaching*, I think it would read :

Teacher gives more;
Students gain more;
Teacher gives less;
Students gain less;
There are no shortcuts in teaching!

20) ADDITIONAL VOLUNTARY TUTORIALS (USUALLY DURING FREE PERIOD)

During the course of the term, usually before a test, I put on an *Additional Voluntary Tutorial*, which usually lasts from 45 minutes to an hour, although, I am quite happy to continue as long as they want me to stay. They can ask, me to do anything from solving a problem to repeating some theory. I have had as many as 80% of a class turn up to one of these sessions. Strangely enough as each student leaves an *Additional Voluntary Tutorial*, they thank me for it. This never happens after a normal lecture!

These study sessions take an extra 8 to 10 hours of my time for all classes during the average term, less if I am teaching two sections of the same course. However, the positive response of my students during a normal class and during an *Additional Voluntary Tutorial* justifies ever minute of them. I used to call *Additional Voluntary Tutorial, Additional Study Sessions*. However, I had to change the name because on one particular day, without thinking and for speed, I wrote the acronym for *Additional Study Sessions* in big letters on the board and then wondered why my students were laughing! We do not spell this word like this in England!

21) MARKING SCHEME FOR ALL TESTS (AVAILABLE TO STUDENTS) WITH PARTIAL CREDIT THROUGHOUT ALL QUESTIONS

My students do not compete against each other when they are taking a test. I create a complete marking scheme for every question and part of a question for each test. Quite often one part of a question needs a value calculated in a previous part of the question. If that value is wrong the rest of the question will be wrong. However, a student does not get penalized twice. He or she will lose from 2 to 4 marks for the wrong value, but I check the rest of the question that uses the wrong value to see if this wrong value has been used correctly. If the wrong value has been used correctly throughout the rest of the question, no more marks will be lost.

22) CONSTANTLY ASKING QUESTIONS DURING CLASS

As I proceed through each class I constantly ask all different types of questions. The objective is to get my students used to hearing the frequently new Mathematical terms. This substantially increases the interaction between my students and me. In the first week of class, when my students want to ask me a question or answer a question during class, they raise one hand and wait for me to notice them. This seems to be the norm in America. I tell them ***not*** to raise their hand, just call out the question or the answer. This is the norm for me when I was teaching in England. It usually takes a few weeks for me to get them used to calling out their questions and answers. This strategy saves time.

It should be noted that not all questions are equal! I rank questions according to the amount of steps that a student must go through to reach the answer. A *Zero-Step Question* in Statistics would be "What is the name of the resistant measure of center?". There is one answer – the median, no additional thought is required, hence a *Zero-Step Question*. An example of a *One-Step Question* would be "*The median of a symmetric distribution is 6.7, what is the mean of this distribution?*". This time students have to realize that if the distribution is symmetric, the median equals the mean, so the mean is also 6.7. This question requires one thought before it can be answered, hence a *One-Step Question*. I also use *Two-Step, Three-Step Questions* etc., in my classes. I have found that *Multi-Step Questions* produce the best responses and even unexpected responses leading to useful discussion topics.

23) USING A METALANGUAGE WITH THE TI-83 CALCULATOR

The keyboard of the *TI-83 calculator* has white characters on every key, yellow characters either above or above and to the left of all the keys except two, and light blue characters above and to the right of many of the keys. The symbols < > are called *angle brackets*. When I want my students to select a function or command, I write the *key sequence* on the board with the white names on the keys in angle brackets or I say the names of the keys that form the key sequence. I use the symbol → to represent the *right arrow key*, ↓ to represent the *down arrow key* etc. I do not enclose the integers **0**, **1**, **2**, , **9** in *angle brackets* in any *key sequence*, and for speed, I use the character **⌡** on the board to represent the key marked **< ENTER >** on the calculator. Characters, that are output to the screen by the calculator, are shown as *underlined characters* in the **DISPLAY** column in a table. On the board, I use **white chalk** or a **black marker** for a *key sequence* while using an **LCD display unit** to show the effect on the screen. If I write characters output to the screen by the calculator on the board I use **orange chalk** or marker. Note that I use Velcro to stick a large picture of the **TI-83** calculator to one side of the board so that I show my students the position of keys on the keyboard. Using Velcro allows me to fold up my picture and take it away with me or to a different room.

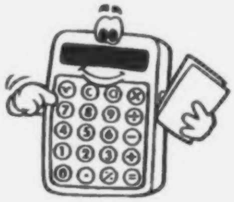
I will use the **QUIT** command as an example. The **QUIT** command takes the user to the *home screen*. It is in yellow above the key marked **MODE** in white. To **QUIT** to the *home screen*, I can instruct my students to press the correct keys by saying "***2nd MODE***", if I am not near the board, or I can write **< 2nd > < MODE >** on the board. My students will know that they must first press the key on the keyboard with **2nd** on it, and then press the key with **MODE** on it. Frequently in class, a student will ask a neighbor how to do something on the **TI-83**, and the other student will shout the *key sequence* back. I have found this strategy saves time, is very simple, and provides my students with a simple method of verbally communicating instructions between students. I am frequently asked to put *Key Sequences* on the blackboard.

AN EXAMPLE OF A KEY SEQUENCE

The ***key sequence*** for the function **normalcdf(20, 1E99, 25, 5)** on the **TI-83** is :

KEY SEQUENCE	SCREEN DISPLAY
< 2nd > < VARS > 2	**normalcdf(**
2 0 < , >	**normalcdf(20,**
1 < 2nd > < , > 9 9 < , >	**normalcdf(20,1E99,** ***Note : (1E99 = +∞)***
2 5 < , >	**normalcdf(20,1E99,25,**
5 <) >	**normalcdf(20,1E99,25,5)**
⌡	**0.8413447404**

I say or write on the board only the characters in the **Key Sequence** column. For example, I will say "***2nd VARS 2***" to paste **normalcdf(** to the *home screen*. I write only the characters in the key sequence column above, on the board, although I include both columns in a hand out.



4. PEER RESPONSIBILITY

4.1 A SUMMARY OF PEER RESPONSIBILITY

All students in my courses work in groups of three (although there may have to be one or even two groups of two, depending on the number of students in a class). I call each group of students a ***partnership*** and each student in a *partnership* a ***partner***. I select three sets of questions from the end of each section of the textbook that will be covered during the course. I call one set of questions **Set A**, the second **Set B**, and the third **Set C**. When each student has completed his/her own set of questions, he or she ***marks*** **one** set of questions completed by **one** of their partners. Each partnership must then organize their work into one *joint workbook*. I call this strategy ***Peer Responsibility***.

One of the objectives of *Peer Responsibility* is to make students discuss the work with each other and to help one another throughout the course. The *marker* can prevent the *solver* from losing marks by identifying questions that are incorrect so that they can be corrected before I see them. If, when a solution reaches me, the solution is correct and the *marker* has marked it as correct, neither student loses any marks. ***Just as important***, the *marker* will not lose marks if the *solver* is unable or unwilling to complete the assigned questions correctly, because the *marker* only needs to recognize whether a question is right, wrong, complete, incomplete, or omitted.

Another objective of *Peer Responsibility* is to increase *student-instructor* interaction. Most students have never marked the work of another student before and some will require advice. The instructor is the most experienced marker, so students will come to him or her for advice. I never tell a student how to mark a question. I always make the student tell me what they are going to do and why they are going to do it. I then ask questions designed to make them think about what they have decided to do until they have solved the problem they were having.

Incidentally, I have always preferred the term *partnership* to *group* because to me the word *partnership* conveys the idea of working closely together. In England, if there were a group of people, who did not know each other, waiting at a bus stop, they would all ignore each other. Indeed I had been over here for several years before I got used to the fact that when walking around the campus, people I did not know would say "Hi" to me. Now when I return to England for a visit, I have to remember to ignore people around me that I do not know!

Marking the workbook is not as onerous a task as it might at first sound, because the solutions have already been marked, and good students will solve and mark most questions correctly. Also the instructor has complete control of how many questions he or she must mark in the workbook. *For each course, I carefully select questions for the workbook so that the questions are challenging and the number to be solved and marked is sufficient to get the partnership cooperating,* ***but*** *I have only 3 to 4 hours of marking to do at the end of* **Session 1** *and* **Session 2**, *and 2 to 3 hours of marking to do at the end of* **Session 3**. In short, there cannot be too many questions per student per session! So I use the questions on the *Example Tests* as a source of further practice, **BUT** these questions do **NOT** have to be marked by the instructor.

I write the Example Tests so that all the topics and concepts in that session are covered. College Algebra may require 25 questions on the Example Test to cover all the topics and concepts. Differential equations may require 14 questions etc. Two of these would be assignments; the remainder would be divided between the partners by the partners. Each partner completes those questions assigned to him or her; they then discuss their solutions with the other partner(s). I make it very clear that all the topics and concepts that could appear on the real test for that session are covered in the Example Test and the workbook problems. To reinforce the importance of the Example Tests, I tell my students that it is essential that they complete the Example Tests because, when I mark the real tests, I can tell who completed them and who did not. **I emphasize that there can be as much as a 20% difference between students who complete the Example Test and those who do not.** The partnerships with good or keen students will divide up, solve and discuss the questions. There will always be some students who will not be very keen to do any additional work. However, these students will usually be able to see the folly of not completing the Example Tests! Students use *Peer Responsibility* without using more of the instructor's time (except to answer questions when the partnership gets stuck!). I have found that students quickly learn that they will gain the most by cooperating and working together.

Note that you must never supply written solutions to the questions on the Example Tests. If you do your students will not come to you for help and they will not try to solve the questions themselves, they will just read the solutions, gaining far less than if they attempted to complete them on their own or with their partners. Also when they come to see you, let them tell you what they are doing, and then keep asking questions that push them in the right direction until their problem(s) are solved.

I make sure that my students know that if they need help, I am just a phone call away. If there are difficulties, I sort them out either in class, in *Additional Voluntary Tutorials*, or in my office hours. Note that to reduce my workload, I frequently use the same *Example Test* in 2 or more semesters.

Initially, I form all the partnerships on the first day the class meets using a form I refer to as the *Times Not Available Form*. Each student crosses out all the times on this form during the week when they could not meet their partners. When the forms have been completed, I tell them to walk around the room and find students who are free as often as possible when they are free. Students then sit together in class with their partners for the rest of the semester. The *Times Not Available Form* will usually get around 70% to 80% of the students in a class into partnerships that will be successful. However, it will not solve all the problems associated with students working in partnerships. So, usually after three weeks, I collect the workbooks and check to see if each student has completed and marked all the required work. I then re-arrange students in partnerships that are not likely to be successful, into new partnerships according to the following criteria :

1) I put the **workers** together;
2) I put the **non-workers** together;
3) I put students who **miss class** or **who do not follow the rules** together.

Each student can ***choose*** to be in any one of the above three groups. However, I emphasize that each student will gain the most academically and obtain the highest grade, by being a ***worker*** in a partnership with other ***workers***. I will allow only one exception. If ***both*** members of a partnership, or ***all*** three partners, for partnerships of three, request to stay together, then I will leave them together, even if one partner is way behind. Note that if the class divides precisely into partnerships of three, *I take two partnerships of three and divide them into three partnerships of two*. This is so that if a student(s) adds, I have a ready-made partnership in which to place him or her. Also if a student drops, in one of the partnerships of two, I can place the other student into one of the surviving partnerships of two.

To improve the quality of the work, the *solver* can obtain an unlimited number of bonuses from the workbook. It is also possible, although less frequent, for the *marker* to obtain bonuses. In order to make each student try to obtain bonuses and improve the standard of their work, the marking scheme includes a *major unknown* over which they have no control. The Final is worth 40% of the total marks available for the course. Most students can see the wisdom of trying to obtain bonuses and improving the standard of their work, in case they have a bad day on the day of the Final.

I bring some completed workbooks from a previous semester along to the first day of class so my students can see what a workbook looks like. I, then, put them on reserve in the library so they can have another look later on if they want to. The workbooks I put in the library are from courses that are **NOT** running during the current semester – to prevent copying. Usually in the first week of class I assign some questions for the workbook. I recommend that these questions be completed over the first weekend of the semester. However, I tell students not to start marking until the second week of the semester, in case one of their partner's drops or a new student joins their partnership.

Almost every semester I receive at least one workbook from every class whose presentation is far superior to those of other partnerships. So that I can review the workbooks and allocate bonus marks for these workbooks, all workbooks are handed to me on the day of the Final. I record any bonus marks for the workbooks in a column in the *Attendance Register*, so that it is added to any attendance bonuses that have been accrued, and automatically transferred to the *Marks Register*. After the Final, I post a sheet of paper on my door and ask students to sign it if they want their workbook returned to them.

Full details about the *marking scheme* and *Peer Responsibility* are in a set of notes called "*A Guide to Partnerships*". On the first day of class, I tell my students to obtain a copy of it. I also tell them that there will be an ***open-book*** multiple-choice test on this set of notes, at the beginning of the second week of the semester. I refer to this test as the *Structure Test*. There is only one *Structure Test*. Every student in every class in every course takes the same *Structure Test*. I never change it. The day the students take the *Structure Test* is shown in the *Semester Plan* I hand out with the syllabus on the first day of class. While there are no make-up tests for *Test 1* and *Test 2* (the missed marks are added to the Final), I do let students take the *Structure Test* if they miss it, because I want them to understand the structure of the course.

There are **20** multiple-choice questions on the *Structure Test*, each worth **1** mark. These **20** possible marks are **bonus** marks (the maximum number of marks for the course is **1020**, assuming no other bonuses). I tell my students that they must have a **red pen** on the day the *Structure Test* is marked because they will be marking the test of the appropriate partner. Any student without a red pen loses **5** marks. It usually takes about **15** minutes to complete the test and about **10** minutes for the students to mark their partner's test. I encourage discussion during the marking of the test.

I start the test about **15** to **20** minutes before the ***end*** of a class and mark it at the beginning of the next class. There is good reason for this! If you start the test at the beginning of a class, you could lose the remaining class time because their will always be a few students who spend the entire class period completing the test. However, I noticed that the slower students finish the test very quickly when the end of the class arrives! Also marking the test at the beginning of the next class period, gives those students in the class, who are less organized, a second chance to buy a red pen!

The *Structure Test* introduces students to marking the work of the correct partner for the first time while I am present, to resolve any problems. It also introduces students to the words *solver* and *marker*. Note that students must follow the rules when marking the work of their partner. If they do not, I deduct **1** mark per marking error from their *Structure Test* total.

4.2 SELECTING THE SET A, SET B, AND SET C QUESTIONS

Marking the workbook is not as onerous a task as it might at first sound, because the solutions have already been marked, and good students will solve and mark most questions correctly. Nevertheless the selection of suitable questions for **Set A**, **Set B**, and **Set C** must be done with care. It is desirable to have students solving every possible different type of question for each topic covered in a session, however, in practice, this is impossible because every instructor has many duties outside the classroom. This means that a compromise must be reached. I base the total number of questions to be solved by each student per session purely on the amount of time it takes me to mark them and keep this under control. *I carefully select questions for the workbook so that the questions are challenging and the number to be solved and marked is sufficient to get the partnership collaborating,* ***but*** *I have only 3 to 4 hours of marking to do at the end of* ***Session 1*** *and* ***Session 2****, and 2 to 3 hours of marking to do at the end of* ***Session 3****,* for each course. Using this approach, I have found that the amount of marking I must do is not a problem and the goals of *Peer Responsibility* are still achieved.

Without bonuses, there are a total of 240 marks for the workbook, 120 for correct solutions and 120 for marking all of one of your partner's solutions correctly. Since there are *three sessions* during a semester, there are 40 marks allocated per session that can be lost due to *solution errors*, and 40 marks that can be lost due to *marking errors* – a total of 80 marks per session. Note that if a student loses a total of more than 40 marks in solution errors in one session, then at the top of the first section of the session, the total marks lost due to solution errors must be recorded as –40 (similarly –40, if the marking errors exceeds 40 marks). The objective is to ensure that each student starts each new session with a total of 40 marks each for *solution errors* and *marking errors*. This strategy, together with the notation and a full explanation, is described in detail in the *Guide*.

There are many ways of marking the solutions and the marking in the workbook. I deduct up to 4 marks for each error in each calculation and/or comment within a question or part of a question. I do not try to make each set of questions worth 40 marks per session. I do not even count the total number of marks that can be lost. The list of questions to be completed in the workbook does not have to be complete on the first day of a new semester. I use various methods to assign questions from the textbook to **Set A**, **Set B**, and **Set C**. Three are described below.

Method 1 – Quick and Simple (Least Effort for the Instructor)

When I reach the end of a section in the textbook during class, I mark the selected questions in the textbook with an **A**, **B**, or **C** to the left of the question number (or **ABC** if every student must complete the same question). Then I write them on the board so my students can copy them down. I usually set my students a question to do in class while I select the questions so they are doing something useful. While teaching I have found it very useful having the selected questions marked in the textbook with the appropriate letter(s). I used this method in my *Differential Equations* course in the *Spring 2001 semester*. It was quick and very simple and there were no problems doing it this way. I type the questions into an **Excel** file (discussed in Method 2 below) when I have enough sections completed because it is useful when I am marking and for my records the next time I teach the course.

Method 2 – Keeping a Few Sections in Front

Students frequently want to know the assigned questions before we have finished a particular section. So sometimes I select the questions for the workbook for the current section and the next two or three sections in the textbook. I either write them on the board and my students copy them down, or I insert them into an file called ***QuestionsForTheWorkbook#***, where the **#** represents a course uniquely, and copy this file into my computer area so my students can print it. This file has a column for the chapter number, the section number, and three columns labeled **Set A**, **Set B**, and **Set C**. It is easy to use and looks similar to the sheet shown on the next page. This sheet includes all the Statistics questions for the workbook for the entire semester (see *Method 3* below). At the end of a course this sheet provides the instructor with a complete list of all the assigned questions for future reference.

Method 3 – A Complete List of the Questions for the Workbook

STATISTICS IS THE ONLY COURSE I TEACH THAT HAS A COMPLETE LIST OF THE SET A, SET B, AND SET C QUESTIONS FOR THE ENTIRE COURSE AVAILABLE AT THE BEGINNING OF THE SEMESTER. This is because I have taught this course many times over the last ten years. The complete list of questions is in an **Excel** file called ***QuestionsForTheWorkbookM205*** (M stands for Mathematics and 205 is the course number in the catalog). The content of this file is included on the next page.

QUESTIONS FOR THE WORKBOOK

Fall 2003 *M205 - ELEMENTARY STATISTICS* *from Mike Bankhead*

		SESSION 1		
CH	**SEC**	**SET A**	**SET B**	**SET C**
1	1.1	24, 35	26, 34	25, 38
	1.2	55	55	55
	1.3	106	96	107
2	2.1	16	NONE	NONE
	2.2	NONE	23	29
	2.3	NONE	NONE	NONE
	2.4	59	68	74
		SESSION 2		
2	2.5	98	101	99
	2.6	OMIT	OMIT	OMIT
3	3.1	NONE	NONE	NONE
	3.2	12	14	12
	3.3	53	48	49
	3.4	NONE	NONE	NONE
4	4.1	NONE	NONE	NONE
	4.2	17	18	19
	4.3	53	52	48
	4.4	75	75	75
	4.5	98	94	97
5	5.1	11	11	11
		SESSION 3		
5	5.2	31	32	38
6	6.1	10	22	19
	6.2	46	49	46
	6.3	NONE	NONE	NONE
	6.4	66	66	66
7	7.1	NONE	NONE	NONE
	7.2	48	49	58
	7.3	OMIT	OMIT	OMIT
8	8.1	13	17	19
	8.2	32	43	45
CH	**SEC**	**SET A**	**SET B**	**SET C**

4.3 THE "A GUIDE TO PARTNERSHIPS" NOTES AND THE STRUCTURE TEST

Full details about which set of questions each partner completes, which set they must mark, and how to mark the work of another student, are included in a set of notes called "*A Guide to Partnerships*". The marks for completing a set of questions and for marking a partner's work are part of the 1000-mark total for the course. Almost all of the questions for the workbook must be completed outside of class time. I put a copy of these notes into my computer area and instruct my students to obtain a copy of it. The guide starts on the next page of this paper.

I tell my students that there will be a multiple-choice open book test about the guide during the second week of the semester. I refer to this test as the *Structure Test*. The test contains 20 multiple-choice questions. It usually takes about 15 minutes. Each question is worth *1 mark* so they can obtain 20 marks as a bonus. This is equivalent to 2%. I allow my students to reference the guide at throughout the test.

A copy of the reference version of the *Structure Test* follows the *Guide* (*Page 79*). The file name of this version is **StructureTestReferenceVersion**. It contains the answers and references to the Guide. The filename of the version that my students answer is **StructureTestStudentVersion**.

For the duration of the course the partners forming each partnership must sit together in class so that they can work together during the course. When I finish a topic, I sometimes assign different questions, one to the each partner. When the partners have completed their own questions, they mark a partner's question while I am in the room, so I can answer any queries they may have. I also combine partnerships in class and have partners from other partnerships marking questions. The objective is to increase the interaction between students. This strategy works very well indeed.

The teaching methodology **STAPRM** combines the Special Techniques and Peer Responsibility. Over the last four years I have used **STAPRM** in all my College Algebra, Precalculus, Calculus, and Differential Equations courses. **STAPRMJ** is a combination of Special Techniques, Peer Responsibility, and Joint Projects I use it in all my Elementary Statistics courses. **STAPRMJ** will be described in a separate paper.

My objective over the last few years has been to find a way of reducing Math Anxiety, improve standards, maximize student participation and student interaction in my classes, and make my students responsible for the progress of other students on the course. A combination of Special Techniques and Peer Responsibility in all the Mathematics courses I teach has gone way beyond even my most optimistic expectations in achieving these objectives and has produced an exciting teaching methodology. What is even better is it the fact that my students clearly enjoy it and I do too!

A GUIDE TO PARTNERSHIPS

by

Mike Bankhead

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DEFINITION OF THE TERMS USED IN THIS GUIDE	
TERM	**DEFINITION**
Answer	The term *answer* refers to the value, expression, or statement that concludes the question. In Example 3, Page 8, Step 3 is the *answer*.
Initials	The word "*initials*" means the first letter of your first name followed by the first letter of your last name, in *capital letters*. For example, the *initials* for *Mike Bankhead* would be MB (clearly, this is not the normal meaning of the word *initials*).
Section	All textbooks are divided into chapters; many of the chapters are divided into smaller parts that I refer to as *sections*. For example, Chapter 1 may have three ***sections*** numbered 1.1, 1.2, and 1.3.
Session	Each semester is divided into 3 parts, ***Session*** *1*, ***Session*** *2*, and ***Session*** *3*.
Solution	A solution to a question or part of a question consists of *two parts*, the *working* and the *answer*. In Example 3, Page 8, Steps 1 and 2 are the *working*, Step 3 is the *answer*, and all three steps are the *solution*.
Workbook	This is a folder or binder, which, initially, contains blank paper. The solutions to the questions assigned at the end of each section of the textbook are written in this binder.
Working	The term *working* refers to the entire solution *without* the answer. In Example 3, Page 8, Steps 1 and 2 are the *working*.

1. THE MARKING SCHEME FOR THE ENTIRE COURSE

The complete marking scheme for the entire course is included here so you can see how the workbook fits into the course. Your **final grade** for the course will be obtained from the following :

1.1	**INDIVIDUAL ASSIGNMENTS (6 IN ALL) *OR* JOINT PROJECTS (3 IN ALL)**	120
1.2	**YOUR SOLUTIONS IN THE WORKBOOK**	120
1.3	**MARKING ALL THE SOLUTIONS OF ONE OF YOUR PARTNERS**	120
1.4	**TWO IN-TERM TESTS**	
	Test 1	120
	Test 2	120
1.5	**COMPREHENSIVE FINAL**	400
	GRAND TOTAL	1000

1.1 INDIVIDUAL ASSIGNMENTS *OR* JOINT PROJECTS (120 MARKS)

In all courses students complete ***either*** *assignments* ***or*** *joint projects*. In all courses involving assignments, there will be six assignments to be completed during the semester, ***two*** questions from **Example Test 1**, ***two*** from the **Example Test 2** and ***two*** from the **Example Final**. Each question will be marked out of **20** for a total of **120**, with all six questions completed by each student ***individually***. They do ***NOT*** have to be marked by a partner. For courses with projects, there will be **three** *joint projects* assigned during the semester, each marked out of **100**. The marks for all three *joint projects* will be combined and scaled to **120 marks**. Assignments and Projects do *NOT* have to be **Peer Checked** and do *NOT* go into the workbook. However, if you let your partner check your assignments, he/she may be able to save you some marks or make some helpful suggestions to help you gain some bonus marks.

1.2 YOUR SOLUTIONS IN THE WORKBOOK (120 MARKS)

There are **120 marks** allocated for the solutions to questions assigned from the textbook. You will lose ***4 marks*** for each *incorrect* question or part of a question. This guide provides full details about the workbook.

1.3 MARKING ALL THE SOLUTIONS OF ONE OF YOUR PARTNERS (120 MARKS)

There are **120 marks** allocated for correctly *marking* the solutions completed by ***ONE*** of your partners. You will *lose* ***4 marks*** if, you mark a question or part of a question as incorrect when it is correct *or* as correct when it is incorrect. This guide provides full details about the workbook.

1.4 THE INDIVIDUAL IN-TERM TESTS (240 MARKS)

There will two in-term tests. Each test will be completed individually and marked out of **100**. These two test scores will be added together and then scaled to **240**.

1.5 INDIVIDUAL COMPREHENSIVE FINAL (400 MARKS)

The Final is comprehensive. It is completed individually and will be marked out of **100** and scaled to **400**.

2. CALCULATING YOUR GRADE THROUGHOUT THE COURSE

There is an **Excel 2000** file in my computer area that allows you to calculate your mark and grade at the end of each of the three sessions in a semester, and to forecast the grade you need in the **Final** to obtain the grade you want for the course. For courses with assignments, the name of this file is **YourGradeAssignments**. For courses with projects, the name of this file is **YourGradeProjects**. The instructions are in the first worksheet in each workbook.

Without bonuses, there are a total of **240 marks** for the workbook, **120** for correct solutions and **120** for marking one of your partner's solutions correctly. Since there are *three sessions* during a semester, there are **40 marks** allocated per session that can be lost due to *solution errors*, and **40 marks** that can be lost due to *marking errors* – a total of **80** marks per session.

REMEMBER : **YOU ONLY LOSE 4 MARKS IF ONE OR PART OF ONE SOLUTION IS INCORRECT OR FOR MARKING IT INCORRECTLY,**

IF IT IS WRONG WHEN I SEE IT

IF YOUR PARTNER THINKS THAT ONE OF YOUR SOLUTIONS, OR PART OF ONE OF YOUR SOLUTIONS IS INCORRECT,, CHECK IT WITH HIM/HER, AND IF IT IS INCORRECT, CORRECT IT, *BEFORE* HANDING YOUR WORKBOOK TO ME! IF YOU ARE THE MARKER, PLEASE REMEMBER THAT IT COULD BE THAT YOUR PARTNER IS RIGHT AND YOU ARE WRONG!

TALK TO EACH OTHER - HELP EACH OTHER

3. GENERAL INFORMATION ABOUT YOUR WORKBOOK

The entire class will be divided into groups of three.. Each group of students will be referred to as a **partnership**. Each student in a *partnership* will be referred to as a **partner**. For some classes, there may have to be one, or even two, partnerships of two, depending on the number of students in the class. On the first day of class, I will help you find your partners. ***You and your newfound partner(s)*** will need to sit together throughout the course so that you can work with your partners during class.

Each partner completes a large number of questions in the textbook during the course in what I call a **workbook**. *Most of these questions will be completed outside of the class*. Initially a **workbook** consists of a binder containing blank paper. Each partnership needs ***ONE*** binder. This workbook (binder) will contain all the questions assigned from the textbook from ***all three*** partners in a partnership of three or from ***both*** partners in a partnership of two.

At the end of *Week 3*, I will collect the workbooks and check to see if you have completed and marked all the assigned questions - ***I do not mark them***. Each workbook will be returned with a **Three-Week Partnership Report** inside. I will leave students who have completed and marked all the assigned questions together. I refer to these students as *workers*. I will reassign partners who are behind, depending on how much of the workbook they have completed. I refer to these students as *non-workers*. I will also re-arrange partnerships so that students who attend form partnerships, and students who do not attend or do not follow the rules in this guide, form partnerships. **In short**,

1) I will put the *workers* together;
2) I will put the *non-workers* together;
3) I will put students who *miss class* and/or do ***NOT*** *follow the rules* together.

YOU can choose to be in any one of the above three categories. However, **REMEMBER** you will gain the most academically and obtain the highest grade, by being a *worker* in a partnership with other *workers*. I will allow only one exception. If ***both*** or ***all*** three partners in a partnership, request to stay together, then I will leave you together, even if one partner is way behind, misses class, or has not followed the rules.

The semester is divided into three ***sessions***. At the end of each *session*, I will collect your *workbooks*, mark them, and return them to you. All the important dates that you need, for the entire course, are on one sheet of paper I call a ***Semester Plan***. There is a black and white copy of it in the syllabus. I have put a copy of your Semester Plan into my computer area. So you can obtain a color copy of it, if you wish. Its filename is either **SemesterPlanProjects#** or **SemesterPlanAssignments#**, where the **#** identifies the semester and your course uniquely.

Please note that, in the event of a complaint from a student(s) about another student(s), ***I will check the facts by discussing the problem with ALL members of the partnership***, before making a decision.

IMPORTANT

PLEASE REMEMBER THAT, THROUGHOUT THE COURSE, *IT IS YOUR RESPONSIBILITY* TO LET ME KNOW IF YOU ARE HAVING DIFFICULTIES WITH YOUR PARTNER(S) SO THAT I CAN RESOLVE THE PROBLEM(S) AS QUICKLY AS POSSIBLE.

ALSO, IF YOU DO *NOT* HAND IN YOUR WORKBOOK AT THE END OF ANY SESSION, ALL MEMBERS OF THE PARTNERSHIP WILL *LOSE* ALL 80 WORKBOOK MARKS FOR THAT SESSION (THIS IS 8% OF THE MARKS FOR THE COURSE).

3.1 THE QUESTIONS YOU MUST COMPLETE IN YOUR WORKBOOK

I will distribute one sheet of paper that contains the **Set A**, **Set B**, and **Set C** questions in three separate columns. These are the questions that you and your partners must complete in your workbook. Initially, these lists may not be complete or the question columns may be blank. I will write the questions for each set on the board as the semester progresses and you can add them to this list. *The questions listed on this one sheet of paper are the only questions that must be completed and marked in the workbook.*

3.2 SET A, SET B, OR SET C?

Sections 3.2.1 and *3.2.2* tell you how to assign the sets of questions to the students in your partnership. If your partnership contains ***two*** students, read *Section 3.2.1* below and ***skip*** *Section 3.2.2*. If your partnership contains ***three*** students read *Section 3.2.2* below and ***skip*** *Section 3.2.1*.

3.2.1 Partnerships with Two Students

For partnerships with *TWO* students, if your last name starts with a letter closer to the beginning of the alphabet than your partners, you do **Set A**, otherwise you do **Set B**. You ***mark*** your partner's questions. When a partnership involves just two students you ***both*** ignore **Set C**. The **Set C** set of questions is only completed when there are *three students* in a *partnership*.

3.2.2 Partnerships with Three Students

For partnerships with *THREE* students, if your last name starts with a letter closest to the beginning of the alphabet than your two other partners, you do **Set A**, the next closest completes **Set B**, and your third partner completes **Set C**. You mark *ALL* of just *ONE* of your partner's questions. The following table shows you the questions you must ***mark***.

YOU COMPLETED	SET A	SET B	SET C
YOU MARK	SET B	SET C	SET A

You complete only ***YOUR*** set of questions in the *workbook* (i.e. **Set A**, **Set B**, ***or*** **Set C**), and mark the set of questions of ***ONE*** of your partners. Most of the questions in your workbook will be completed outside of class time. There is ***NO*** extra credit for *completing* or *marking* more than one set of questions. Specific instructions on how to mark your partner's work are included in ***Section 5*** of this guide. In your **Workbook**, put **ALL Set A** questions together, **ALL Set B** questions together, and **ALL Set C** questions together.

3.3 THE WORKBOOK MARKING NOTATION

When your workbook is returned to you, at the top of each section, you will see the letter **S**, for *marks lost due to* Solution *Errors*, made by the ***Solver***, followed by an arrow and then a number, for example, **S → –9**. This means that **9 marks** have been *lost* due to solution errors. Immediately below this will be the letter **M**, *for marks lost due to* Marking *Errors*, made by the ***Marker*** who *marked that particular set of questions*, followed by an arrow and then a number, for example **M → –15**. This means that **15 marks** have been lost due to marking solutions as incorrect, when they were correct, or as correct, when they were incorrect.

The notation for this, written with a green pen, at the beginning of this section would be

S → –9
M → –15

Throughout your workbook negative numbers correspond to **lost** marks while *positive* numbers correspond to **bonus marks**.

On the first page of each new *session* you will see a number to the right of $\mathbf{S_T}$. The subscript **T** stands for **Total**. This is the **total** number of marks the *solver* lost (*if the number is negative*) due to solution errors during that session. Underneath this you will see a number to the right of $\mathbf{M_T}$. This is the **total** number of marks the *marker* lost (*if the number is negative*) due to marking errors during that session. *Please check them*. If you use the **Your Grade** worksheet to calculate your mark and grade throughout the course, the value of $\mathbf{S_T}$ in *Session 1*, including the negative sign, if you have lost marks due to solution errors, is entered in the white box to the right of **S1 Wb Solution Errors ($\mathbf{S_T}$)**. The value of $\mathbf{M_T}$ in *Session 1*, including the negative sign, if you have lost marks due to marking errors, is entered in the white box to the right of **S1 Wb Marking Errors ($\mathbf{M_T}$)**. Repeat this process for the other two sessions. Note that if you lose a total of more than **40 marks** in solution errors in one session, you will see $\mathbf{S_T \rightarrow -40}$ at the top of the first section of the session ($\mathbf{M_T \rightarrow -40}$ if you lose a total of more than **40 marks** in marking errors in one session). This strategy ensures that you start each new session with a total of **40 marks** for *solution errors* and *marking errors*.

3.4 OBTAINING BONUSES IN YOUR WORKBOOK

If your answer to a question or a graph is very good, you could obtain additional marks as ***bonuses***. For example, any number with a plus before it, such as **+1** or **+3**, is a bonus mark. When completing your solutions you should think carefully about how to obtain bonuses. By the end of the course they could help improve your grade or cancel out the effect of a poor test mark. ***THERE IS NO LIMIT TO THE NUMBER OF BONUSES THAT YOU CAN OBTAIN FOR YOUR SOLUTIONS IN YOUR WORKBOOK***.

4. YOUR SOLUTIONS

You must use loose-leaf paper in your workbook. Each **section** of your solutions must be ***clearly labeled*** with your *name*, the *section number* from the textbook, and the *set of questions you completed* (i.e. **Set A**, **Set B**, or **Set C**). Each solution must be completed in ***PENCIL*** and **clearly numbered**. If a solution is not in pencil I will mark it as **incorrect**. ***NOTE THAT YOU MAY USE COLORED PENS OR PENCILS FOR GRAPHS OR DIAGRAMS.*** Your partner must mark your solutions with a ***RED*** pen. If the marker does not use a red pen or omits his/her initials, I will mark the marking as **incorrect**. I will use a ***GREEN*** pen to mark your solutions and check your partner's marking. ***Markers*** *do* ***not*** *put a mark of any kind through the question number or the part letter –* ***I need it***!

If you wish to correct an incorrect solution, complete an omitted question or part of a question that was omitted, or complete the correct question, then you need to refer to **Section 6** of this guide. *Section 6* explains how to correct any type of error before your *workbook* is handed to me. Then provided the corrected solution is correct, before I see it, the *solver* will not lose any marks.

4.1 THE TWO-DAY RULE (*Giving Your Partner Time to Mark Your Work*)

If you fail to give your partner a ***MINIMUM*** of **two days** prior to the due date, to mark your work, ***and he/she complains to me***, I will add the number of marks your partner would have lost, to ***YOUR*** **Solution Error total (MAXIMUM 20 MARK PENALTY)**, even if ***ALL*** your solutions are correct. Your partner will receive other work to mark. ***This rule is applied ONLY when a complaint is received from a student.***

5. HOW TO MARK YOUR PARTNER'S WORK

IT IS ***NOT*** YOUR JOB TO CORRECT YOUR PARTNER'S WORK OR TO TRY TO GET YOUR PARTNER TO CORRECT SOLUTIONS THAT YOU HAVE MARKED AS WRONG

Your marks, for marking one of your partner's solutions, depend ***ONLY*** on marking incorrect solutions with an ***X** and your "initials"* and correct solutions with a *check mark and your "initials"*. I use the word "initials" to mean the first letter of your first name followed by the first letter of your last name, in **capital letters**, so I can read them without difficulty (for me this would be **MB**). This is illustrated in *Example 1*. Note that when I mark a question that has one or more parts marked by you as incorrect, then if they are incorrect, I will decide whether or not your partner loses any marks for the incorrect part(s) of the question.

You will ***lose* up to 4 marks** for each solution marked incorrectly, if it is still marked incorrectly ***WHEN I SEE IT!*** This means that you will not lose any marks if you mark a solution as wrong, if it is wrong. *Please remember to discuss a solution that you believe to be wrong with your partner, in case the solution is correct and you are wrong!* **If your partner fails to complete a substantial portion of a set of questions, then I will give you a set of questions so you will not lose any *Marking Marks*.**

Feel free to add brief comments, such as NO DIAGRAM, OMITTED PART, or anything else that seems appropriate. I have even seen GOOD JOB! followed by a *smiley*, written by a student alongside their partner's work. This could be helpful to your partner and to me! If you need to add additional checks or crosses in a solution to help you check the solution, then feel free to do so.

5.1 MARKING A CORRECT OR INCORRECT QUESTION

You must mark your partner's work with a ***RED pen***. You must put a ***check mark*** (***for correct***) or an **X** (***for incorrect***) to the ***left*** of each question number you mark *TOGETHER WITH* your *initials*. *Example 1* illustrates the correct procedure for questions without parts, while *Example 2* illustrates the correct procedure for questions with two or more parts. Please DO NOT put a check mark, an **X**, your "initials", or anything else through the question number or the part letter – ***I need it*** !.

EXAMPLE 1 – FOR QUESTIONS WITHOUT PARTS

Question 24 is correct hence the check mark, and *Question 26* is incorrect, hence the **X**.

✓ MB **24)** $3x^2 - 12x + 12 = 3(x^2 - 4x + 4) = 3(x-2)(x-2) = 3(x-2)^2$

X MB **26)** $3x^2 - 12x + 12 = 3(x^2 - 4x + 4) = 3(x-4)(x-4) = 3(x-4)^2$

where **MB** = Mike Bankhead.

EXAMPLE 2 – FOR QUESTIONS WITH PARTS

For questions with **TWO or more** parts, put a check mark or **x**, as appropriate, plus your initials, to the left of ***each part*** of the question. For example, *Question 19*, below, has three parts, *Parts a)* and *c)* are correct, hence the check marks and "*initials*", while *Part b)* is incorrect, hence the **x** plus "*initials*".

19)

✓ MB **a)**

✗ MB **b)**

✓ MB **c)**

NOTE

WHEN YOU PRINT A COPY OF THIS GUIDE, THE CHECK MARK, x, AND MY INITIALS, IN THE ABOVE EXAMPLES, WILL NOT BE PRINTED IN RED, UNLESS YOU USE A COLOR PRINTER.

5.2 QUESTION ONLY OR CORRECT ANSWER ONLY

A solution that consists of just the question and nothing else is **WRONG** and must be marked with an x and your initials, as shown in *Example 1, Question 26*.

A question number followed by just the correct solution, or the question itself followed by the correct solution with no working in between is **INCORRECT**, *if working is needed*. Be careful when you are marking your partner's work, some questions need no working so the answer only is appropriate. If your partner has completed a question of this type incorrectly and you marked it as wrong, then you will not lose 4 marks. However, your partner will lose 4 marks for a *solution error*, unless he/she chooses to correct the solution *before* I see his or her work. Your partner should refer to **Section 6**, which explains how to correct a solution before your workbook is handed to me.

5.3 CORRECT ANSWER USING INCORRECT METHOD

A ***solution*** consists of two parts, the ***working*** and the ***answer***. It is quite common for a student to end up with the correct *answer* with the *working* leading up to it **INCORRECT**. You must mark such a question as **INCORRECT**. I found the problem shown in *Example 3* in the workbook of one of my student's. The *marker* had marked it as correct. Both the *marker* and the *solver* lost 4 marks.

EXAMPLE 3 – CORRECT ANSWER BUT INCORRECT WORKING

X MB 26) $2m^{\frac{1}{3}}(3m^{\frac{2}{3}} - m^{6}) = 6m^{\frac{1}{3}\times\frac{2}{3}} - 2m^{\frac{1}{3}\times 6}$ **STEP 1** } **(WORKING)**

$= 6m^{\frac{3}{3}} - 2m^{\frac{6}{3}}$ **STEP 2**

$= 6m - 2m^{\frac{19}{3}}$ **STEP 3** **(ANSWER)**

Step 1 and **Step 2** are the *working*, while **Step 3** is the *answer*. The wrong rule has been applied in **Step 1** – the exponents have been multiplied together instead of added, and the exponent in the second term of **Step 2** is not the same as the correct exponent in the second term of the answer. So in spite of the fact that the answer is the correct answer from the back of the book, this question is ***INCORRECT*** because the ***working*** is incorrect. Therefore this question ***MUST*** be marked as ***INCORRECT***.

If your partner's *working* is wrong and you marked it as wrong, then you will not lose 4 marks. However, your partner will lose 4 marks for a *solution error*, unless he/she chooses to correct the working *before* I see his or her work. Your partner should refer to **Section 6**, which explains how to correct a solution before your workbook is handed to me.

5.4 OMITTED QUESTION OR PART OF A QUESTION

If your partner has ***omitted the solution to a question or part of a question completely*** from his/her set of questions, write an X and your **initials** on the left side of the page, followed by the number of the omitted question or the letter of the omitted part of a question in a **red circle**, placed where the omitted question or part of a question should be. For example, if the questions to be completed were numbers **25**, **27**, **28**, **30** and your partner had omitted question **27**, then put an X and your initials on the left side of the page, followed by a **RED CIRCLE** with **27** in **RED** inside. This should be placed between the solutions to questions **25** and **28**. Similarly if part **b** of question **30** has been omitted put an X and your initials on the left side of the page, followed by a **RED CIRCLE** with **b** in **RED** inside. These situations are illustrated in *Example 4*.

EXAMPLE 4 – OMITTED SOLUTION OR PART OF A QUESTION

25)

X MB ㉗

28)

30)

a)

X MB ⓑ

c)

81

When the solution to a question or part of a question has been omitted or the wrong question has been completed (see **Section 5.5**), the marker ***MUST*** mark the correction. ***These are the only times when the marker marks a correction***. *If this solution is still omitted when your workbook is handed to me for marking,* ***only the solver*** *will lose marks.*

If your partner chooses to complete the omitted question, and you mark it, before I see his or her work, then provided the solution is correct when I see it, no marks will be lost. Your partner should refer to **Section 6**, which explains how to include an omitted question before your workbook is handed to me.

5.5 WRONG QUESTION COMPLETED

If you find that your partner has completed the wrong question from his/her set of questions, write an x and your initials on the left side of the question number as usual. Then write the words "WRONG QUESTION" in red immediately above the question.

For example, if your partner had completed question **27** instead of question **29**, then you (the *marker*) must put an x and your initials to the left of the question number with the words "WRONG QUESTION" in **red** immediately above the question, as shown in *Example 5*.

EXAMPLE 5

WRONG QUESTION

X MB **27)** $(2x + 3)(4x - 7) = 8x^2 - 14x + 12x - 21$

$= 8x^2 - 2x - 21$

This will ensure that you do not lose *your* 4 marks if your partner chooses not to complete the correct question. *However, your partner will lose* **4** *marks if the solution to the omitted question is still omitted when your workbook is handed to me for marking.*

If your partner chooses to complete the correct question, **you MUST mark it**, in the normal way. Then, whether the question is right or wrong, you will not lose any marking marks. Your partner should refer to **Section 6**, which explains how to include the correct question before your workbook is handed to me.

5.6 OMITTED GRAPH(S) OR DIAGRAM(S)

If a question, or any part of a question, requires a graph(s) or diagram(s) to be drawn, and it (***or any one of them***) has been omitted, the question or part of a question is **WRONG**. You **MUST** mark the question or part of a question with an **x** plus your initials, see *Example 1 – Question 26* and *Example 2 – Question 19b*.

If your partner chooses to complete the omitted graph or diagram, **you MUST mark it**, in the normal way. Then, whether the graph/diagram is right or wrong, you will not lose any marking marks. However, your partner will lose 4 marks, unless he/she chooses to include the missing graph(s) or diagram(s), as required by the question, ***before I see it***. Your partner should refer to **Section 6**, which explains how to include a missing graph(s) or diagram(s) before your workbook is handed to me.

6. CORRECTING A SOLUTION *BEFORE* I MARK IT

If your partner marks one of your solutions as incorrect ***and it is incorrect***, your partner will ***not*** lose ***4 marks*** when I see it, because he/she has marked the question correctly. However, ***you will*** lose ***4 marks*** unless you provide a correct solution. You may do this by writing the correct solution on a blank page and inserting this page ***immediately following*** the page on which the incorrect solution is written or omitted. Then providing this solution is correct, you will not lose ***4 marks***.

YOUR PARTNER DOES NOT HAVE TO MARK YOUR CORRECTIONS.

HOWEVER, YOUR PARTNER MUST MARK A QUESTION OR PART OF A QUESTION IF IT HAS BEEN OMITTED, OR THE CORRECT QUESTION IF THE WRONG QUESTION WAS COMPLETED

The procedure for correcting an incorrect solution is illustrated in *Example 6*. It is your job as the solver inserting a corrected solution to write the words "**CORRECTED NEXT PAGE**" and "**CORRECTION**" in ***pencil*** in the correct positions, as shown in *Example 6*. *These phrases are for my benefit.*

NOTE THAT : **ONLY QUESTIONS THAT HAVE BEEN *ATTEMPTED IN FULL* AND FOUND TO BE PARTLY INCORRECT OR TOTALLY INCORRECT CAN BE CORRECTED FOR CREDIT.**

EXAMPLE 6

An Incorrect Question Correctly Marked by Both Partners

X MB **26)** $(2x-5)(3x+7) = 6x^2+14x-15x+35$

$= 6x^2-x+35$

CORRECTED NEXT PAGE

The Corrected Question On the Following Page

The following solution will be the only solution on the inserted page if there are no other incorrect solutions on the same page.

CORRECTION

26) $(2x-5)(3x+7) = 6x^2+14x-15x-35$

$= 6x^2-x-35$

If you omitted a solution, part of a solution, or completed the wrong question, the phrases are "**OMITTED SOLUTION NEXT PAGE**" and "**OMITTED SOLUTION**" respectively. If there is *more than one wrong solution* on the same page, you may put more than one correction on the inserted page.

THE STRUCTURE TEST *from Mike Bankhead*

NAME OF SOLVER	NAME OF MARKER	COURSE #	# CORRECT

1) The word "initials", as used in this guide, means **(Definitions – P1)**

a) your normal initials written the way you would normally write them;
b) the first letter of your first name followed by the first letter of your last name, using upper or lower case letters;
✻ **c)** the first letter of your first name followed by the first letter of your last name, in capital letters;
d) None of the above.

---

2) Assuming no bonus marks have been earned **(Chapter 1 – P1)**

a) the total number of marks allocated for the workbook is the same as the number of marks allocated for one of the in-term tests;
✻ **b)** the total number of marks allocated for the workbook is the same as the total number of marks allocated for both in-term tests;
c) the number of marks allocated for your solutions in your part of the workbook is the same as the number of marks allocated for both of the in-term tests;
d) None of the above.

---

3) The file you would use to calculate your mark and grade throughout the course is : **(Chapter 2 – P2)**

a) a **Word 2000** file with filename **YourGradeAssignments**.
b) a **Word 2000** file with filename **YourGradeProjects**.
✻ **c)** an **Excel 2000** file with filename **YourGradeAssignments (for courses with assignments)**.
✻ **d)** an **Excel 2000** file with filename **YourGradeProjects (for courses with projects)**.

---

4) You will lose 4 marks if **(Chapter 1 – P2)**

a) one of your solutions is wrong, but you complete a correct solution in accordance with the instructions on page 10 of the set of notes called "*A Guide to Partnerships*";
b) your partner marks one of your solutions as wrong although it is in fact correct;
c) you mark a solution, which is wrong, and it is wrong, although your partner completes a correct solution that you choose not to mark;
✻ **d)** None of the above.

---

5) You will need to buy : **(Chapter 3 – P3)**

a) three binders if there are three students in your partnership;
b) two binders if there are two students in your partnership;
✻ **c)** only one binder per partnership;
d) None of the above.

---

6) At the end of the third week you will hand in your joint workbook. I will then : **(Chapter 3 – P3)**

a) mark all the work;
b) mark and correct your work;
c) check how well you marked your partner's work;
✲ **d)** check to see if each partner has completed and marked ***ALL*** the assigned work.

---

7) If a partner, who has attended regularly, is re-assigned to a different group at the beginning of the fourth week, it will be based on : **(Chapter 3 – P3)**

✲ **a)** how much of the assigned questions he or she completed and marked (whether they have been solved correctly or marked correctly is irrelevant);
b) how many of the questions he or she solved correctly;
c) how many of the questions have been marked correctly;
d) None of the above.

---

8) You find your partners on the first day of class. The set of questions you and your partners complete are labeled **Set A, Set B**, and **Set C**. **(Sections 3.2.1, 3.2.2 – P4)**

a) The set of questions ***you*** complete is based upon the alphabetical order of your first names;
✲ **b)** The set of questions ***you*** complete is based upon the alphabetical order of your last names;
c) ***You*** complete whichever set of questions you want to complete;
d) None of the above.

---

9) The marking notation $\begin{matrix} \mathbf{S} \to -2 \\ \mathbf{M} \to 1 \end{matrix}$ means that the : **(Section 3.3 – P5)**

a) solver has lost 2 marks due to solution errors while the marker has lost 1 mark due to marking errors.
✲ **b)** solver has lost 2 marks due to solution errors while the marker has obtained 1 bonus mark from marking.
c) solver has gained 2 marks due to bonuses while the marker has lost 1 mark due to marking errors.
d) None of the above.

---

10) The total number of marks you can obtain from the workbook is : **(Section 3.3.1 – P5)**

a) 120;
b) 240;
✲ **c)** ≥ 240;
d) None of the above.

---

11) Which of the following statements is true? **(Chapter 4 – P5)**

a) Your solutions must be completed using any pen, but you must mark your partner's work using a red pen;

b) Your solutions must be completed using a pen or pencil, but you must mark your partner's work using a red pen;

c) Your solutions and your marking must be completed in pencil;

✻ **d)** Your solutions must be completed in pencil and you must mark your partner's work using a red pen.

---

12) If I look at a question that has a check mark plus initials, to the left of the question number, and the solution is correct : **(Section 5 – P6)**

a) Both the student who completed the question and the marker would lose 4 marks;

b) The student who completed the question would lose 4 marks but the marker would not lose any marks;

c) The student who completed the question would not lose 4 marks but the marker would lose 4 marks;

✻ **d)** Neither the solver nor the marker would lose 4 marks.

---

13) When you mark your partner's work : **(Section 5.1 – P6)**

a) you must circle any errors;

b) you must ensure your partner corrects his or her errors;

✻ **c)** you must put an **x** (for incorrect) ***or*** a check mark (for correct) together with the first letter of your first name followed by the first letter of your last name in red ***only***;

d) you must put an **x** ***or*** a check mark, together with the first letter of your first name followed by the first letter of your last name in pencil ***only***.

---

14) If, when marking your partner's work, you find the correct question number but no working or answer and your partner decides to hand the workbook to me for marking like this : **(Section 5.2 – P7)**

a) You can ignore it without losing any of your own marks;

✻ **b)** You must put an **x** plus your initials in red only;

c) You must put an **x** plus your initials in pencil only;

d) You will both lose 4 marks whatever action you take.

---

15) If, when marking your partner's work, you find the correct question number followed by the correct answer but no working : **(Section 5.2 – P7)**

a) You can ignore it without any possibility of losing any of your own marks;

b) You must put an **x** plus initials in red only. This will ensure that you will not lose any marks;

✻ **c)** You must check the question to make sure that the answer with no working is appropriate for that question, and if it is you must put a check mark plus your initials in red. However, if working is required, you must put an **x** plus your initials in red.

d) You and your partner will lose 4 marks whatever action you take.

---

16) A **solution** to a question consists of the **working** followed by the **final answer**. If the *final answer* to a question is correct : **(Section 5.3 – P7)**

- **a)** There is no need to check the working because it must be correct;
- ✲ **b)** The working could be wrong even though the final answer is correct;
- **c)** You can put a check mark plus your initials to the left of the question number and be sure that you will not lose any marks;
- **d)** None of the above.

---

17) If, when marking your partner's work, you notice that he or she has omitted a question or part of a question completely, and your partner decides not to complete the omitted question :

(Section 5.4 – P8)

- **a)** You can ignore it without losing any of your own marks;
- **b)** You must put the number of the missing question in a circle with an **x** and your initials to the **right** of the question number. In this case your partner will lose 4 marks, if he/she did not complete the question before I receive the workbook, but you will not lose any marks;
- **c)** You will both lose 4 marks whatever action you take;
- ✲ **d)** None of the above. **(should be X + initials + missing question # in a circle *IN THIS ORDER*)**

---

18) If, when marking your partner's work, you notice that he or she has completed the wrong question and your partner decides not to complete the correct question : **(Section 5.5 – P9)**

- **a)** You will both lose 4 marks whatever action you take;
- **b)** You can ignore it without losing any of your own marks;
- **c)** You must put the number of the missing question in red in a red circle with an **x** plus your initials to the left of it. In this case your partner will lose 4 marks but you will not lose any marks;
- ✲ **d)** None of the above. **(needs WRONG QUESTION)**

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19) If, when marking your partner's work, you notice that he or she has omitted a diagram or graph that is required by the question and your partner decides not to draw it : **(Section 5.6 – P9)**

- **i)** You must mark it as if it was wrong, even if the working and the final answer are totally correct;
- **ii)** If the working and the answer are correct you must mark the question or part of a question with a check mark plus your initials;
- **iii)** If the question has two or more parts, you must mark the part that should have a diagram or graph wrong, even if the working and the answer for that part are totally correct.

- **a)** Only **(i)** is correct
- ✲ **b)** **(i)** and **(iii)** are correct
- **c)** **(i)**, **(ii)**, and **(iii)** are correct
- **d)** All are wrong

---

20) If your partner marks one of your questions with a **x** and it is wrong : **(Chapter 6 – P10)**

- **a)** You can ignore it without losing any of your own marks;
- **b)** You can erase the solution (or the part that is wrong) and replace it with the correct solution (or correct part).
- **c)** You will both lose 4 marks whatever action you take;
- ✲ **d)** You can insert the correct solution on a blank piece of paper that must be inserted immediately following the page that contains the incorrect solution. Your partner does ***NOT*** have to mark the corrected solution.

---

5. ANALYSIS OF THE EVALUATION FORMS

5.1 The Special Techniques

A copy of the evaluation form I used to obtain the data on the next few pages is on *Pages 88 to 92*. I used Statistics courses because it was the latest data available. The *Techniques* or statements from my evaluation form are listed in the first column of **Tables 1**, **2**, and **3** in the order of preference from highest to lowest. This column is labeled **POS** (for *Position*). The actual technique or statement that appears in the evaluation form is given in the second column. The third column, headed $\bar{x}$, is the *mean* for the technique or statement. The maximum possible value in this column is **5**. The fourth column contains the *standard deviation* for each technique or statement. Every set of data for each technique or statement formed a sample that was approximately normally distributed with some mild outliers present in some samples, however, there was no deviation from normality to forbid the use of t-procedures. Although there was a maximum of score of **5** for each, a *95% confidence interval* for each technique and statement was calculated using the *t-distribution*. It is displayed in the fifth column with the *degrees of freedom* listed in the sixth column. The values for t^* were obtained from *Table E* in the textbook "*An Introduction to the Practice of Statistics*" by Moore and McCabe, 3rd Edition. The number in the seventh column is the number of the technique in the part of my evaluation form from which it came. The shaded rows in each table correspond to those techniques or statements that have equal means.

From **Table 1** it can be seen that there is a substantial overlap of the *confidence intervals*. While it is possible to say that the top five techniques (those in Positions 1, 2, 3, 4, and 4) are definitely preferred to any of those in the bottom three. Unfortunately, the order of those techniques within the top five is not clear because of the overlapping confidence intervals. The main problem is the small sample size. However, over the next few years I expect to teach between 150 and 200 students. This should give me in excess of 150 completed evaluation forms. With a sample size this large, the t-distribution can be used even in the presence of outliers, so I expect these results to give me a better idea of my student's preferences.

It is interesting to note that, after omitting those techniques that were not part of an older evaluation form, the top five techniques in my non-statistics courses were exactly the same as the top five techniques in my Statistics courses, except for a slightly different order. The order for the previous evaluation form is shown below on the left, while the order in the latest evaluation form is shown below on the right.

1) Provide an Example Test Before Each Real Test (Including the Final) - ***1st***
2) Graded Bonuses on all Tests (to encourage them to think during the Test) - ***Joint 4th***
3) ***Never*** Require Students to Remember Formulae ***BUT*** Must Know ***When*** to Use a Formula and, If the Formula has been Forgotten, Must Know Where to Find It - ***7th***
Joint 4) Take One Sheet of Paper into a Test Including the Final - ***2nd***
Joint 4) All Questions on the Tests Straight from or Similar to Questions in the Textbook - ***Joint 4th***

Techniques 3, 8, and 22, below, were not included on this older evaluation form.

Technique 3) No Time Limit on Tests, Including the Final (as far as possible) - ***3rd***
Technique 9) Unlimited Bonuses Available for the Solutions in the Workbook - ***6th***
Technique 20) Using a *Metalanguage* with the TI-83 Calculator - ***5th***

It is clear from **Table 1** and from older evaluations, that *Example Tests*, and *being allowed to take one sheet of paper into a test*, is very important to my students, in spite of the fact that they gain no additional marks from either of these two techniques. Moreover in **Table 2**, "*being allowed to take one sheet of paper into a test*" came in first among those techniques designed to reduce worry (or Maths Anxiety) with *Example Tests* a close second. Also not being forced to remember formulae turned out to be very important. These three techniques are so easy to implement and have such a positive effect on my students that I believe they should be used in every Math's course.

TABLE 1 - FROM PART 1 OF MY EVALUATION FORM (PAGE 88)

1	2	3	4	5	6	7
POS	**SPECIAL TECHNIQUE**	$\bar{x}$	**s**	**95% C.I.**	**df**	**#**
1.	Provide an Example Test Before Each Real Test (Including the Final)	4.72	0.46	(4.49, 4.95)	18	**2.**
2.	Take One Sheet of Paper into a Test Including the Final	4.39	0.61	(4.09, 4.69)	18	**4.**
3.	No Time Limit on Tests, Including the Final (as far as possible)	4.33	0.69	(3.99, 4.67)	18	**3.**
4.	All Questions on the Tests Straight from or Similar to Questions in the Textbook	4.28	0.57	(3.99, 4.56)	18	**5.**
4.	Graded Bonuses on all Tests	4.28	0.67	(3.95, 4.61)	18	**7.**
5.	Using a Metalanguage with the TI-83 Calculator i.e. **< STAT > < → > 1** etc.	4.24	1.19	(3.62, 4.85)	17	**22.**
6.	Unlimited Bonuses Available for the Solutions in the Workbook (It is possible to cancel out a poor assignment or test mark with these bonuses)	4.22	0.88	(3.79, 4.66)	18	**9.**
7.	*Never* Require Students to Remember Formulae *BUT* Must Know *When* to Use a Formula and, If the Formula is Forgotten, Must Know Where to Find It.	4.28	1.16	(3.58, 4.77)	17	**6.**
8.	Top 25% in Final Rule (Provided ALL Assignments/Projects and Workbook Completed)	4.17	0.71	(3.82, 4.52)	18	**11.**
9.	90% or More in Final Rule (Provided ALL Assignments/Projects and Workbook Completed)	4.11	0.68	(3.78, 4.45)	18	**10.**
10.	**a)** Completing Your Own Sets of Questions in the Workbook	4.06	0.64	(3.74, 4.37)	18	**12a.**
11.	Use the Textbook as a Set of Notes to Minimize the Amount of Writing Students Do In Class	4.00	1.17	(3.40, 4.60)	17	**16.**
11.	Marking Scheme for All Tests (Available to Students) with Partial Credit throughout All Questions	4.00	0.69	(3.66, 4.34)	18	**21.**
12.	Make and Use Transparencies of Graphs, Rules, etc. So Time is Not Wasted Drawing or Writing Them on the Blackboard.	3.94	0.64	(3.63, 4.26)	18	**17.**
13.	Create *Alternative Methods* For Those Topics that Cause Difficulty	3.88	1.19	(3.27, 4.49)	17	**19.**
14.	Showing Students Errors Made by Students in Previous Courses.	3.83	0.71	(3.48, 4.19)	18	**14.**
15.	Provide Complete Solutions to Some Typical Problems Written Using the Language of Mathematics Correctly	3.82	1.09	(3.26, 4.39)	17	**1.**
16.	Use Colored Chalk on the Blackboard	3.72	0.89	(3.28, 4.17)	18	**18.**
17.	Additional Voluntary Tutorials During Free Period	3.71	1.10	(3.14, 4.27)	17	**20.**
18.	Constantly Asking Questions During Class	3.61	0.78	(3.22, 4.00)	18	**22.**
19.	**b)** Marking One of Your Partner's Questions	3.44	0.98	(2.96, 3.93)	18	**12b.**
20.	Any Numerical Answer Requires a Sentence Containing the Number in the Context of the Question.	3.06	1.16	(2.48, 3.63)	18	**13.**

TABLE 2 - FROM PART 2 OF MY EVALUATION FORM (PAGE 89)

POS	STATEMENT	$\bar{x}$	s	95% C.I.	df	#
1.	I found that being able to take a sheet of paper into every test made me worry less about the test.	4.72	0.57	(4.44, 5.01)	17	9
2.	I found that the instructor's use of colored chalk on the blackboard helped make the work on the blackboard clearer.	4.67	0.69	(4.33, 5.01)	17	2
3.	I found completing the workbook gave me the practice I needed to prepare me for the tests.	4.61	0.50	(4.36, 4.86)	17	3
4.	I found that having Example Tests before the real test made me worry less about the real test.	4.50	0.86	(4.07, 4.93)	17	8
5.	Being able to obtain bonus marks on any test made me think about how to obtain them during a test.	4.44	0.62	(4.14, 4.75)	17	10
6.	I was very conscientious and diligent when completing my own solutions and marking my partner's work.	4.39	0.61	(4.09, 4.69)	17	7
7.	I gained a lot from completing my solutions in the workbook.	4.22	0.94	(3.75, 4.69)	17	5
8.	This is the average number of Chapter Summaries per student (5 = Every student copied every Chapter Summary).	4.06	1.72	(3.17, 4.95))	16	1
8	I enjoyed working with my partners on the workbook	4.06	0.87	(3.62, 4.49)	17	4
9.	The fact that all the questions on tests were straight from the textbook made me complete more questions from the textbook.	3.94	1.21	(3.34, 4.55)	17	11
10.	I gained a lot from marking my partner's solutions in the workbook.	3.39	1.20	(2.79, 3.98)	17	6
11.	I enjoyed creating the joint projects.	3.22	1.06	(2.69, 3.75)	18	12

TABLE 3 - FROM PART 2 OF MY EVALUATION FORM (PAGE 90)

POS	STATEMENT	$\bar{x}$	s	95% C.I.	df	#
1.	Overall, I rate this INSTRUCTOR an excellent teacher.	4.61	0.50	(4.36, 4.86)	17	14
2.	I found this course challenging.	4.33	0.91	(3.88, 4.78)	17	15
3.	Overall, I learned a great deal in this course.	4.12	1.41	(3.39, 4.84)	16	17
4.	I enjoyed this course.	4.11	0.83	(3.70, 4.53)	17	13
5.	I found this course interesting	4.00	0.84	(3.58, 4.42)	17	16
6.	The instructor was late (1 = Never)	1.00	0.00	(1.00, 1.00)	17	18

Table 3 contains the last six statements from Part 2 of my evaluation form in the order of preference for this same group of students. I was very pleased with the score for the "*I enjoyed this course*" statement. In fact over 50% of these students indicated that this statement was "Definitely True". However, I did have a few students who indicated that being roasted alive in boiling oil was preferable to being in one of my *Statistics courses*!

5.2 Peer Responsibility

I have developed a far better form during this term, however, I do not have sufficient data available at this time to include it in this paper. The evaluation form included in this paper is the one immediately prior to it. Many students just wrote "*Yes*" under or alongside the following questions. However, below are the written comments from those students who wrote something other than "Yes". I have typed the comments exactly as they appeared on the evaluation forms (including punctuation and errors). When the codes like S1 or S2 etc., at the beginning of each sentence, are the same, it indicates that the same student made the comments to different statements. The underlined comments are mine.

3) IS THERE ANYTHING (OR THINGS) THAT YOU LIKED ABOUT THIS COURSE?

S1 Projects, workbooks, partnerships
S2 Example Test, the one sheet of paper for tests, doing example problems in class for each section, the workbook, the tutorial (the last word refers to the *Additional Voluntary Tutorials*)
S6 I liked the Example Tests. They were very helpful. I liked the sheet of paper we could bring in during the test. I liked you going over the problems until we understand them
S7 You, Dr. Bankhead and your cheerful spirit! You were very crucial in my learning in this class. (This does not seem to refer specifically to either the *Special Techniques* or *Peer Responsibility* – but I really liked this one!)
S8 I liked the example tests, working with partners, bonus points and use of calculators
S9 The workbook helped out a lot. Also the chapter summaries and the example tests
S10 I liked the bonuses on all work. It made me understand what I was doing by making me write out everything about a solution and why it was.
S13 I like the opportunities to work with partners, that helped me out a lot with homework and projects.
S14 Examples of previous tests helped to know what to expect

5) DID WORKING IN PARTNERSHIPS HELP YOU, IF SO, HOW OR IF NOT, WHY NOT?

S1 Partnerships helped me by my partners understanding problems that I did not understand and vice versa
S3 Yes, when something was difficult it was good to have someone to confer with.
S5 Yes and No One of the partners wouldn't show up but the other was very helpful because I was able to see her point of view on some questions.
S7 Yes, my partners were beneficial in helping me understand more difficult sections.
S8 Yes this helped because we helped each other out.
S11 Yes, motivated me to do the work in the textbook
S12 Yes – I was able to practice each section and also see how my partners worked things out.
S13 Yes, it helped understand me the homework and the projects.
S14 Yes, because it taught me to work in a group

7) DID YOU USE THE YourGrade FILE - Circle → YES NO ? DID YOU FIND IT HELPFUL?

Most students answered "*Yes*" to this question, very few included a comment. Here is just two!

S4 NO - I like to hold off potentially bad news until the very last ☺ (the smiley was included!)
S6 I found it very helpful. It helped me keep up with my progress

I was very pleased with most of the comments in the *Question 5 Statements*. However, I was disappointed that so few wrote comments. I am hoping that my newly developed form will generate more detailed comments.

5.2.1 Past Comments from My Students about Peer Responsibility

The first time I introduced Peer Responsibility into my courses was in the fall of 1999. I tried it first in my *M105 - College Algebra* and *M116 – Pre-Calculus courses*. I told them at the outset that *Peer Responsibility* was an experiment and I did not know whether it would be successful or not. To the question "*Do you feel that marking your partner's work was beneficial to you?*" 70% of my *M105 – College Algebra* class agreed they did, while 69% of my *M116 – Pre-Calculus* students said they did. This was in spite of the very experimental nature of *Peer Responsibility* during that term. When I used *Peer Responsibility* for the first time in my M301 – Differential Equations course, I had it much better organized and this percentage rose to 87.5% (14 out of 16).

It was noticeable that those students who said they did not benefit from *Peer Responsibility,* had a low mark for the "*satisfaction with your partnership*" question. So I have fine tuned my methods of creating successful partnerships. Many of my students felt quite happy to put their names and email addresses on my forms, even when some of their answers were not quite what I wanted to see! Even students who felt they did not benefit from *Peer Responsibility* still told me that it was worthwhile continuing the experiment.

Many students just wrote "*Yes*" under or alongside the following questions. However, below are the written comments from those students who wrote something other than "Yes". I have typed the comments exactly as they appeared on the evaluation forms (including punctuation and errors). When the codes like S1 or S2 etc., at the beginning of each sentence, are the same, it indicates that the same student made the comments to different statements.

5) DID MARKING YOUR PARTNER'S WORK HELP YOU, IF SO, HOW OR IF NOT, WHY NOT?

S1 : Yes, because I learned from their mistakes and so on
S2 : Yes, it gave me the practice in doing the problems
S4 : Yes, my partner helped me understand things which I did not understand
S5 : It did some
S6 : Yes – we were able to talk about the problem we had diff. answer too (I assume diff. = different)
S7 : Yes, because it forced me to really examine how the work was completed

6) OVERALL DID YOU FEEL THAT THE OBJECTIVES OF THIS EXPERIMENT MADE IT WORTHWHILE?

S2 : Yes, I believe it helped me a lot
S3 : Yes I do! It makes it easier for a non test taker to get an A

7) SHOULD I CONTINUE THIS EXPERIMENT, AFTER IMPROVING THE STRUCTURE BASED UPON THE EXPERIENCE I HAVE GAINED WITH YOU, OR SHOULD I ABANDON IT?

S1 : Yes, continue it because it was helpful
S2 : Continue it
S3 : Yes! I believe it would only help people to raise their grade
S4 : Continue it
S5 : Keep it
S6 : Yes – but bigger groups (3-4 people) might be better to get more variety
S7 : continue

ADDITIONAL INFORMATION REQUEST

NAME (Optional) ______________________ **Course** ______________

Email Address (Optional) ______________________________

PART 1 - SPECIAL TECHNIQUES

---

0. NOT APPLICABLE
1. NO HELP AT ALL
2. A LITTLE HELPFUL
3. HELPFUL
4. VERY HELPFUL
5. ESSENTIAL

---

1) Provide Complete Solutions to Some Typical Problems Written Using the Language of Mathematics correctly. ☐

2) Provide an Example Test Before Each Real Test (Including the Final ☐

3) No Time Limit on Tests, Including the Final (as far as possible) ☐

4) Take One Sheet of Paper into a Test Including the Final ☐

5) All Questions on the Tests Straight from or Similar to Questions in the Textbook ☐

6) *Never* Require Students to Remember Formulae *BUT* Must Know *When* to Use a Formula and, If the Formula is Forgotten, Must Know Where to Find It. ☐

7) Graded Bonuses on all Tests ☐

8) Unlimited Bonuses Available for the Solutions in the Workbook (It is Possible to cancel out a poor assignment or test mark with these bonuses) ☐

9) 90% or More in Final Rule (Provided ALL Assignments/Projects and Workbook Completed) ☐

10) Top 25% in Final Rule (Provided ALL Assignments/Projects and Workbook Completed) ☐

11) **a)** Completing Your Own Sets of Questions in the Workbook ☐

11) **b)** Marking One of Your Partner's Questions ☐

12) Any Numerical Answer Requires a Sentence Containing the Number in the Context of the Question. ☐

13) Showing Students Errors Made by Students in Previous Courses. ☐

14) Chapter Summaries in my Computer Area ☐

15) Use the Textbook as a Set of Notes to Minimize the Amount of Writing Students Do In Class ☐

16) Make and Use Transparencies of Graphs, Rules, etc. So Time is Not Wasted Drawing or Writing Them on the Blackboard. ☐

17) Use Colored Chalk on the Blackboard ☐

18) Create *Alternative Methods* For Those Topics that Cause Difficulty ☐

19) Additional Tutorials During Free Period ☐

20) Marking Scheme for All Tests (Available to Students) with Partial Credit throughout All Questions ☐

21) Constantly Asking Questions During Class ☐

22) Using a Metalanguage with the TI-83 Calculator i.e. **< STAT > < → > 1** etc. ☐

PART 2

---

0. NOT APPLICABLE **1. DEFINITELY FALSE** **2. MORE FALSE THAN TRUE**
3. IN BETWEEN **4. MORE TRUE THAN FALSE** **5. DEFINITELY TRUE**

---

1) Circle the number of each *Chapter Summary* that you copied from my computer area :

0 NONE CH 2 CH 3 CH 4 CH 5 CH 6

2) I found that the instructor's use of colored chalk on the blackboard helped make the work on the blackboard clearer. ☐

3) I found completing the workbook gave me the practice I needed to prepare me for the tests. ☐

4) I enjoyed working with my partners on the workbook. ☐

5) I gained a lot from completing my solutions in the workbook. ☐

6) I gained a lot from marking my partner's solutions in the workbook. ☐

7) I was very conscientious and diligent when completing my own solutions and marking my partner's work. ☐

8) I found that having Example Tests before the real test made me worry less about the real test. ☐

9) I found that being able to take a sheet of paper into every test made me worry less about the test. ☐

10) Being able to obtain bonus marks on any test made me think about how to obtain them during a test. ☐

11) The fact that all the questions on tests were straight from the textbook made me complete more questions from the textbook. ☐

12) I enjoyed creating the joint projects. ☐

13) I enjoyed this course. ☐

14) Overall, I rate this INSTRUCTOR an excellent teacher. ☐

15) I found this course challenging. ☐

16) I found this course interesting.. ☐

17) Overall, I learned a great deal in this course. ☐

18) The instructor was late ***(Circle the appropriate response)*** :

NEVER **RARELY** **OCCASIONALLY** **FREQUENTLY** **ALWAYS**

PART 3 - FOR STATISTICS COURSES *ONLY*

(For Question 1 only) Project = 1 2 3

1) What percent of the work did YOU do for each *joint project* (approximately)? ☐ ☐ ☐

2) How many students were in your joint project partnership (including you)? ☐

3) How many times did you and your partners meet this term : ☐

4) How many times were ALL members of your partnership present: ☐

5) On a scale of 1 to 5, where 1 is *did not work well* and 5 is *worked very well*, how would you rate *your* satisfaction with your partnership's work on the projects? ☐

6) Do you feel that you and your partners spent sufficient time on each joint project? ☐ YES ☐ NO

PART 4 - FOR ALL COURSES *INCLUDING* STATISTICS

1) How many students were in your workbook partnership (including you)? ☐

2) How many times did you and your partners meet this term : ☐

3) How many times were ALL members of your partnership present: ☐

4) On a scale of 1 to 5, where 1 is *did not work well* and 5 is *worked very well*, how would you rate *your* satisfaction with your partnership's work on the workbook? ☐

5) Do you feel that you and your partners spent sufficient time on each project? ☐ YES ☐ NO

PART 5

1) IS THERE ANYTHING I COULD HAVE DONE FOR YOU OR GIVEN YOU THAT WOULD HAVE HELPED YOU MORE? IF SO, WHAT?

2) IS THERE ANYTHING (OR THINGS) THAT YOU DID NOT LIKE ABOUT THIS COURSE?

3) IS THERE ANYTHING (OR THINGS) THAT YOU LIKED ABOUT THIS COURSE?

4) CAN YOU THINK OF ANY WAY OF IMPROVING THIS COURSE?

5) DID WORKING IN PARTNERSHIPS HELP YOU, IF SO, HOW OR IF NOT, WHY NOT?

6) DID YOU FIND THE TI-83 NOTES HELPFUL – WHY? HOW COULD I IMPROVE THEM FOR YOU?

7) DID YOU USE THE YourGrade FILE - Circle → YES NO ? DID YOU FIND IT HELPFUL?

6. COURSE METHODOLOGY, CONTENT, AND COST

In order to allow the *techniques* to be effective, it was necessary to modify my teaching style. I needed more time during a lecture to interact with my students more effectively. *Peer Responsibility* has united my students and me in a way that would never have thought possible. I was able to reduce the amount of time spent writing on the blackboard by using the textbook as a set of notes, (*Technique 16*) and making transparencies of graphs, solutions to questions from the textbook etc., (*Technique 17*). I also use a laser pointer in all of my classes. This means that I do not have to be close to the overhead projector or the board. I now find that I spend far more time either facing my students or moving around among them while asking questions. This seems to make my students more relaxed and willing to talk. Using *colored chalk on the board,* (*Technique 18*), makes what I am doing on the board clearer. I can emphasize common errors, like a minus sign before a bracketed expression, using red chalk (or a red marker) or a rule using yellow chalk (or a yellow marker) etc.

All my lectures are now interactive discussions covering each section of the textbook. I use many transparencies of various parts of the textbook. Throughout every lecture I constantly ask questions about the material I am covering to keep my students involved (*Technique 22*). The *Additional Voluntary Tutorials,* (*Technique 20*), also causes many students to be more relaxed. During or after one of these, they are quite happy to chat about topics other than Maths and this effect spills over into the normal lecture.

Working with their partner's on the *workbook,* (*Peer Responsibility*), gives them the practice they need. It is also popular because, if something goes wrong, they can gain bonus marks by improving the standard of their work or by completing questions very well. There are also bonus marks available in all the assignments and tests (*Technique 7*). Either of these can make up for a bad test or final.

The *one sheet of paper,* (*Technique 4*), *Example Tests,* (*Technique 2*), *using questions from the textbook,* (*Technique 5*), together with making sure that they were not competing against the clock during a real test (*Technique 3*), seems to have successfully reduced the worry about taking a Maths test. The *Additional Voluntary Tutorials,* (*Technique 20*), has increased the student-instructor interaction. The possibility of *gaining bonus points on a test,* (*Technique 7*), is also attractive to many, since it reduces the number of marks needed for a good grade on the Final (every Final is worth 400 marks out of 1000 for the entire course). The *90% or more in the Final rule,* (*Technique 10*), and the *Top 25% in the Final Rule,* (*Technique 11*), creates hope for some and motivates many as well. I created the *Top 25% in the Final Rule* because the *90% Rule* was so effective.

Providing *complete solutions to typical problems,* (*Technique 1*), has certainly improved the answers in the tests. It also shows students what I want, which in turn reduces anxiety. I now find my students demanding more solutions! Even demanding a *sentence for a numerical answer,* (*Technique 13*), which I wanted because I disliked giving full marks to just a number, and creating an *Alternative Method,* (*Technique 19*), which is fun for me, have both received some very positive comments. The *Semester Plan,* in Chapter 2, provides each student with all the important dates on one handy sheet of paper. It also helps me complete everything on schedule.

After using the *Special Techniques* and *Peer Responsibility* in my classes for four years, I have found the atmosphere in my classroom is far more relaxed and my students are certainly more confident and willing to talk. Also my students and I are more united than I would have thought possible and teaching my courses using **STAPRM** is certainly so much better than it was and a lot of fun as well!

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6.1 COURSE INFORMATION FROM MY SYLLABUS

The goals, objectives, and content of my *M105 – College Algebra* and my *M205 – Elementary Statistics* are listed below as they appear in the syllabus for each course. I have also used **STAPRM**, as described in this proposal, in my *M116 – Pre-Calculus, M117-Calculus 1, M301 – Differential Equations* and my M405 – *Numerical Analysis courses*. I use **STAPRMJ** in my *Elementary Statistics* courses. However, this pedagogy includes the *Special Techniques* and *Peer Responsibility*. Both **STAPRM** and **STAPRMJ** have been well received by the majority of my students in all the courses in which I have used it. In fact, my courses are overflowing with students!

M105 –College Algebra Goals, Objectives, and Content

a) Textbook

There are no prerequisites for this course. I will present the course assuming that you have no prior knowledge of *Algebra*. The following **required** text can be purchased from the bookstore :

College Algebra by Raymond Barnett, Michael R. Ziegler, and Karl E. Byleen
7th Edition, Publisher : McGraw-Hill

b) Course Goals and Objectives

The objective of **M105 - College Algebra** is to prepare students for Precalculus, Business Calculus, or Elementary Statistics. This course is the basic building block for these later courses. There will be an increased emphasis on conceptual understanding in addition to algorithmic skills. *(Why* is as important as *How*). Computers or graphing calculators will be incorporated into the course, in ways that develop understanding. (The "black box" approach will be avoided). There will be an emphasis on problem-solving and using multiple approaches i.e. graphical, symbolic, numeric.

Upon completion of **Maths 105 - College Algebra** the successful student will :

1) be familiar with the real number system (including complex numbers) and its properties;
2) be able to manipulate Exponents, Radicals, Rational expressions, and Polynomial and Rational Inequalities
3) be able to solve Linear equations, a System of Linear Equations, Linear inequalities, and Quadratic equations;
4) be able to understand the Remainder and Factor Theorems and the Fundamental Theorem of Algebra;
5) be able to find the Zeros and Factors of a Polynomial;
6) be able to Graph Lines and Circles;
7) understand the concept of a Function and be able to carry out Operations on Functions, including Polynomials, Rational Functions, Inverse Functions, and Exponential and Logarithmic Functions.

b) Course Content

The objective of this course is to provide an introduction to *Algebra*. This course addresses the *Quantitative Literacy* goal and the *Thinking Skills* goal of Bellarmine's core curriculum (Items 6 and 7 on Page 43 of the 2001 – 2003 Bellarmine University Catalog).

A description of the ***M105 – College Algebra*** course can be found in the *2001 – 2003 Bellarmine University catalog* on Page 202. It is as follows :

> Taught as a preparatory course to remedy deficiencies in algebra. Logic, properties of real numbers, linear equations and inequalities, quadratic equations and inequalities, systems of linear equations, polynomials functions, algebraic functions. **Students with credit for Maths 116, 117, or 125 may not enroll in Maths 105**. *Every Fall.*

M205 – Elementary Statistics Goals, Objectives, and Content

a) Textbook

There are **no** *prerequisites* for this course. I will present the course assuming that you have no prior knowledge of *Statistics*. The following **required** text can be purchased from the bookstore :

Introduction to the Practice of Statistics by *Moore and McCabe* - 4th Edition,
Publisher : W. H. Freeman and Company.

b) Course Goals and Objectives

Upon completion of ***Maths 205 Elementary Statistics*** the successful student will be able to :

1) Produce and interpret descriptive statistics, both graphically and numerically;
2) Explain the fundamental issues of sampling and of experimental design;
3) Compute and interpret probability in various situations;
4) Explain the concepts of random variable and distribution;
5) Produce a confidence interval estimate from a given sample;
6) Explain the rationale of hypothesis testing;
7) Carry out – with the aid of technology – a variety of hypothesis tests, including z-tests and t-tests;
8) Use correlation to determine the strength of a linear relationship between two-variable data and apply linear regression to describe this relationship;
9) Use the statistical functions on the TI-83 calculator and understand the theoretical meaning of the output.

c) Course Content

The objective of this course is to provide an introduction to *Statistics* assuming no prior knowledge. This course addresses the *Quantitative Literacy* goal, the *Thinking Skills* goal, and the *Communications Skills* goal of Bellarmine's core curriculum (Items 6, 7, and 8 on Page 42 of the *1999 – 2001 Bellarmine University Catalog*).

The description of ***M205 – Elementary Statistics*** in the *2001 – 2003 Bellarmine University catalog* is as follows :

> Descriptive Statistics; probability; sampling, correlation, and prediction, hypothesis testing, estimation. Two years of high school algebra and one year of high school geometry, or their equivalent, are highly recommended as preparation for this course. *Every semester.*

6.2 COST

6.2.1 The Special Techniques

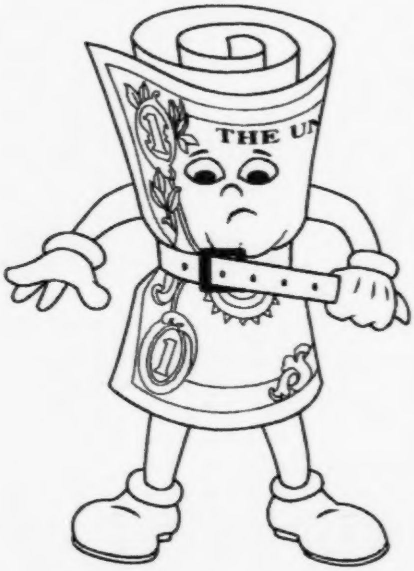
The cost of implementing the *techniques* discussed in this paper is very low. It involves just the cost of Overhead Transparency Slides. I would estimate that the average cost for the slides, assuming a new textbook has been adopted, is less than **$25** per course. This is substantially reduced if there are multiple sections of the course per term and further reduced if the textbook is retained in later terms.

The only notes that I duplicate are the syllabi. There is no cost to my department because I duplicate my notes using a laser printer and the department does not pay for the paper or the toner cartridges.

There is no additional equipment required beyond an overhead projector, which is usually in every classroom anyway. Students purchase the **TI-83** calculators individually, and the projector can be obtained free from **Texas Instruments** once the department requires it to be used for a course. Although not essential, I found a laser pointer very useful. Laser pointers are now very cheap. The one I use was only **$12** and it came with 10 lenses, each of which projects a different image. The cost to the department was nil because I had to pay for it!!!

6.2.2 Peer Responsibility

My students print the set of notes "*A Guide to Partnerships*" in the college during the first week of term on either a laser printer or a color inkjet. I print the *Structure Test* on the department's laser printer. However, since my department does not pay for the paper used, there is no cost to my department for *Peer Responsibility*.



7. CONCLUSION

When I first started this work in the spring of 1995, the objective was to reduce Maths anxiety and improve standards in my College Algebra courses. I also wanted to increase my student's confidence in their mathematical ability and give them a positive attitude towards the course throughout the course. I have now found that the strategies I have developed are equally effective in all my Mathematics courses and have gone far beyond even my most optimistic expectations. I have noticed a substantial difference in the attitude of my students in my courses and this has made teaching them far more pleasant. The atmosphere in the classroom is far more relaxed with substantial interaction between students and between my students and me. Students do not seem to feel as threatened by the subject or by the tests and they remain far happier throughout the course than before I started using **STAPRM**. Even better, it is clear that my students enjoy marking their partners work and putting red marks all over it - it is **fun** for me too!

The *Special Techniques* have more than succeeded in reducing Maths Anxiety, standards have improved, students are clearly at ease and they do believe that they can succeed in my courses. *Peer Responsibility* has maximized student interaction and participation in all my Mathematics courses as well as student-instructor interaction. This strategy has allowed many students to discover that they are not the worst in Maths in the class which substantially reduces their anxiety about the course.

Working with a partner on the workbook unites the students with each other and with me in a way that I would not have believed possible before creating and using *Peer Responsibility*. The bonuses, for improving the standard of their work in their workbook or for demonstrating additional thinking in a test, do give my students the chance to redeem themselves if they receive a poor assignment or test mark. Also the workbook gives my students the additional practice they need to improve their mathematical ability and prepare them for each test.

Since the best way to complete the Example Tests is for the partnership to sit together and solve their own problems with their partners nearby in case they need help, solving the questions on the *Example Tests* also unites students, albeit unwillingly for some of them! The tests also increase student-instructor interaction because they must come to me for help, since I **never** supply written solutions to the questions on the *Example Tests*.

Note that you must never supply written solutions to the questions on the Example Tests. If you do your students will not come to you for help and they will not try to solve the questions themselves, they will just read the solutions, gaining far less than if they attempted to complete them on their own or with their partners. Also when they come to see you, let them tell you what they are doing, and then keep asking questions that push them in the right direction until their problem(s) are solved.

Many of the *techniques* have helped me as well. For example, I enjoy creating *Alternative Methods* (*Techniques* 19) for those topics that cause my students difficulties. I also enjoy creating new ways to teach a topic (*Techniques 16* and *17)*. This increases my interest and enthusiasm, even for topics I have taught hundreds of times before.

Using *Techniques 16* and *17* gives me more time to interact with my class while, much of the time, facing them. When I am discussing a transparency, using a laser pen allows me to wander around the room among my students asking questions. I become a person not someone out the front behind an invisible wall. If an instructor writes constantly on the blackboard with his or her back to the class, it builds a wall between the instructor and the class. If your students can only recognize you from the back – it is time to change your teaching style! These simple techniques allow me to face my students for much longer than before and walk around among them.

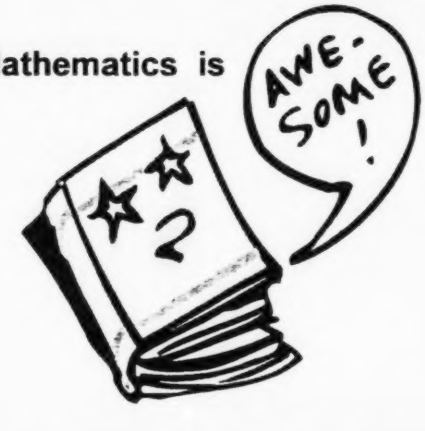
Even more important, I know that the two strategies that form **STAPRM** (*Special Techniques* and *Peer Responsibility*); can be transferred to any Mathematics class at any level with the same positive effects. This is because I have been using **STAPRM** for the last four years in my *M105 - College Algebra*, *M116 – Pre-Calculus*, *M117 – Calculus*, *M301 – Differential Equations*, and my *M405 – Numerical Analysis* courses. I have been told that **STAPRM** could also be used with many other subjects, such as Communications, Education etc. I know that parts of this pedagogy are already being used in a History class.

The essential files and **Excel** workbooks for **STAPRM** will be available to anyone interested in using this teaching methodology, via the Internet by the summer. These files were either created in **Excel** or **Word**. I deliberately created them so that anyone can use them. Only a rudimentary knowledge of **Excel** is needed to use the **MarksRegisterAssignments#** and the **YourGradeAssignments** worksheets (the first tab in both workbooks provides complete instructions). The **Word** documents are not protected so they can be modified as required. All of the **Excel** worksheets are protected, but not password protected, so they too can be changed as required. At this point almost all of my students have used the ***YourGradeAssignments*** worksheet without any problems, and most students do keep a copy of the appropriate ***Semester Plan*** to hand. I always have a copy of the ***Semester Plan***, for the course I am about to teach, on the desk in front of me for each class, to ensure I do not forget something.

I have long held the belief that at the present time teachers are islands. We do not learn from the mistakes of our predecessors and we should. When I started teaching, I completed a teacher-training course, like so many others. I was taught how to teach Maths by an instructor who had never taught Maths in his life. It did not prepare me, in any way, for teaching mathematics to students who started out on the course fearful of it. When I walked into the classroom for the first time thirty-two years ago, I had only my observations as a student to fall back on. I did the best I could, making, I am sure, all the same mistakes my predecessors had made before me. This is not the way it should be. As teachers we should be learning from each other, so that a new teacher has at his or her disposal the combined experience of other Mathematics teachers who have gone before them. I am hoping that the work I am doing now and my future plans will stop a new Mathematics teacher making some of the same mistakes that I made when I first started.

I do not believe a teacher ever stops learning how to teach better and more effectively. I am still trying out new ideas, collecting more data with an improved student evaluation form, and creating new *techniques*. I am currently testing more new ideas. I created, tried, and evaluated the *Top 25% in Final Rule* for the first time last term. As far as my students are concerned, I realized, from the beginning of this work, that I would never be able to pass my love of Maths on to them. However, when over half of them say "*Definitely True*" to the question "*I enjoyed this course*", I feel that substantial progress has been made. I want to write a chapter called "*The Mistakes I Made Creating **STAPRM***". It would discuss all the ideas that I tried but rejected and the mistakes that I made. I think it would be helpful to other teachers and it might help me see rejected ideas in a different light. I also want to include a section that discusses the formulae I use in the *MarksRegisterAssignments#* and the *YourGradeAssignments* worksheets. I have also developed a large number of organization ideas that save an instructor time when using this teaching methodology. I want to present these ideas in a report sometime in the near future. So even after over eight years working on these teaching methodologies, there is still a lot to do!

Mathematics is



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